Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

VIII.

Echinoderms of New Zealand and the Auckland-Campbell Islands.

I. Echinoidea.

By

Dr. **Th. Mortensen.**

(With Pls. VI—VIII).

In publishing this first part of my report on the Echinoderms of New Zealand and the Auckland-Campbell Islands it is my very agreable duty to express my great indebtedness to the New Zealand Government for the courtesy shown me during my visit to New Zealand in November 1914—February 1915. The permit to accompany the G. S. „Amokura" on her trip to the Auckland and Campbell Islands and the G. S. „Hinemoa" on her trip round the North Island of New Zealand was of the most eminent importance to me, enabling me to undertake investigations in those regions which I should otherwise have been unable to accomplish. Rather extensive collections were made during these trips, which will very considerably enrich our knowledge of the marine fauna of these regions. Of course, I feel myself under special obligation to have these collections worked out separately and at the earliest possible opportunity. Some of the reports have already been published (Freeliving Nematodes, by Hj. Ditlevsen, Ascidia, by Pr. Bovien; Bryozoa, by Ernst Marcus, the present report being the fourth of the series[1]) and several more are in preparation; it may be expected that the material will, in the main, have

[1]) These papers have been published in the present volume of this Journal as respectively No.s III, IV and VI of the „Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16".

been worked out in the course of a few years. I beg the New Zealand Government and my New Zealand Colleagues to accept these contributions to the knowledge of the biology of the New Zealand seas as a tribute for the hospitality shown me.

The history of the Echinoderm fauna of New Zealand is rather intricate. Old collections in various Museums of Europe and America from the time when the importance of exact indications of locality had not yet been realized have occasioned many statements of species erroneously said to come from New Zealand. This applies especially to the sea-urchins, whose dried tests are often brought home by sailors a. o. people and then, furnished with unreliable labels, end in the Museums, where they give rise to wrong zoogeographical statements.

Erroneous identifications, partly due to insufficient access to litterature, have caused several other instances of species being wrongly reckoned to the New Zealand fauna. A critical examination of the previous lists of New Zealand Echinoderms therefore leads to some remarkable results and makes the revised list differ very conspicuously from the earlier ones. It is, however, only fair to emphasize that the different aspect of the lists is due partly to necessary nomenclatural changes.

The first list of New Zealand Echinoderms was given by Hutton in his „Catalogue of the Echinodermata of New Zealand" 1872. He names the following 9 species of Echinoids:

Cidaris (*Stephanocidaris*) *tubaria* Lam.
Echinus (*Psammechinus*) *chloroticus* A. Ag.
Echinus elevatus n. sp.
Echinus albocinctus n. sp.
Laganum rostratum Ag.
Arachnoides zelandiæ Gray.
Echinoneus ventricosus Ag. & Des.
Echinobrissus recens M. Edw.
Amphidotus zealandiæ Gray.

In 1876[1]) Hutton adds to this list the species *Strongylocentrotus tuberculatus* Lam., *Sphærechinus australiæ* A. Ag. and *Echinus angulosus* Leske, while *Cidaris tubaria* of the first list is stated to be not this species but *Goniocidaris geranioides* Lmk., *Echinus albocinctus* to be *Ech. magellanicus* Phil., *Ech. elevatus* to be *Amblypneustes formosus* Val., *Amphidotus zealandiæ* to be *Echinocardium australe* Gray and *Arachnoides zelandiæ* to be *A.*[2]) *placenta* L. Finally *Echinoneus ventricosus* is stated not to belong to the New Zealand fauna, and *Laganum rostratum* very doubtfully so. — In 1878[3]) he further adds *Salmacis globator* Ag. to the list, while the former *Cidaris tubaria* is now corrected into *Goniocidaris canaliculata* A. Ag. and immediately thereafter, in a note, recognized to be a new species, which is named *Goniocidaris umbraculum.*

The next addition to the New Zealand Echinoid Fauna is due to Studer, who, in his report on the Echinoids of the „Gazelle" (Monatsber. d. Akad. d. Wiss. Berlin. 1880. p. 873) describes a new species, *Amblypneustes grossularia* from the Three Kings Isl. Further Filhol[4]) states to have found *Echinus margaritaceus* Lam at the Campbell Isl. and in the Cooks Strait. — In 1897 H. Farquhar[5]) adds *Strongylocentrotus erythrogrammus* Val. and *Centrostephanus Rodgersii* Ag. (besides some species from the Kermadec Islands, which do not concern us here). Finally, in 1898[6]) he gives a very complete list of all those species which were then actually known to occur at New Zealand or stated in litterature to do so (especially in Agassiz' „Revision of the Echini" and the „Challenger" Echinoidea). To the species already mentioned the fol-

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[1]) F. W. Hutton. Corrections and Additions to the Catalogue of New Zealand Echinodermata (1872. Trans. N. Z. Inst. IX. p. 362.

[2]) By a lapsus he writes *Echinarachnius* instead of *Arachnoides.*

[3]) F. W. Hutton. Notes on some New Zealand Echinodermata, with descriptions of new species. Trans. N. Z. Inst. XI. p. 305—8.

[4]) H. Filhol. Recherches zoologiques, botaniques, faites à l'ile Campbell et en Nouvelle-Zélande. X. Échinodermes. Recueil de mémoires . . . . rélatifs à l'observation du passage de Vénus sur le Soleil. III. 1885. p. 572—3.

[5]) H. Farquhar. A contribution to the history of New Zealand Echinoderms. Journ. Linn. Soc. Zool. XXVI.

[6]) H. Farquhar. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. 1898.

lowing are added here: *Temnopleurus Reynaudi* Ag., *Amblypneustes griseus* Blv., *Holopneustes inflatus* Ltk., *Brissopsis luzonica* (Gray) and *Metalia sternalis* (Lamk.) (— besides the deep-water forms taken by the „Challenger" in the vicinity of New Zealand and some species from the Kermadecs; these forms are not taken into consideration at the present occasion —).

In the „Index Faunæ Novæ Zealandiæ" 1904 Hutton again eliminates from the list of New Zealand Echinoids the species: *Centrostephanus Rodgersii, Str. erythrogrammus, Sphærech. Australiæ, Holopneustes inflatus, Echinus margaritaceus, Laganum rostratum,* and *Metalia sternalis,* while no new forms are added.

Another addition was again made by Benham, 1909, in his Record of the Echinoderma of the N. Z. Government Trawling Expedition, viz. *Porocidaris elegans* A. Ag. The same author[1]) also showed the „*Salmacis globator*" of Hutton to be a new species of the genus *Pseudechinus*, naming it *Ps. Huttoni.* F. Jeffr. Bell[2]) in 1917 adds two new forms, *Astropyga radiata* Leske and *Laganum* sp. Finally in the present report five new species are added, viz. *Cidaris* sp. *Pseudechinus variegatus* n. sp., *Echinocyamus polyporus* n. sp., *Laganum depressum* Ag. (?) and *Brissopsis zealandiæ* n. sp.

A revised list of the New Zealand Echinoids then looks as follows:

Goniocidaris umbraculum Hutton[3]).

Porocidaris elegans A. Ag. — erroneous identification; = **Ogmocidaris Benhami** n. g. n. sp.

Cidaris sp.

Astropyga radiata Leske — erroneous identification; = **Aræosoma thetidis** (H. L. Clark).

Centrostephanus Rodgersii Ag. — probably not New Zealand.

Temnopleurus Reynaudi Ag. — not New Zealand.

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[1]) W. B. Benham. An erroneous Echinodermal identification. Ann. Mag. Nat. Hist. Ser. 8. Vol. I. 1908. p. 104.

[2]) F. Jeffr. Bell. British Antarctic („Terra Nova") Expedition. Zoology Vol. IV. 1. Echinoderma.

[3]) In the „Index Faunæ Novæ Zealandiæ" this species-name has been curiously misprinted into „*umbulacrum*".

Echinus angulosus Leske — erroneous identification; = **Notechinus novæ-zealandiæ** n. sp.

— *magellanicus* Phil. — erroneous identification: = **Pseudechinus albocinctus** (Hutton).

— *margaritaceus* Lam. — erroneous identification; = *Notechinus novæ-zealandiæ* and *Pseudechinus albocinctus.*

Salmacis globator Ag. — erroneous identification; = **Pseudechinus Huttoni** Benham.

Pseudechinus variegatus n. sp.

Amblypneustes grossularia Studer = **Pseudechinus grossularia** (Studer).

— *formosus* Val. — probably = *Holopneustes inflatus* (Ltk.).

— *griseus* (Blv.) — probably not New Zealand.

Holopneustes inflatus Ltk.

Evechinus chloroticus (Val.).

Strongylocentrotus tuberculatus (Lamk.) = **Heliocidaris tuberculata** (Lamk.).

— *erythrogrammus* Val. — probably not New Zealand.

Sphærechinus australiæ A. Ag. — not New Zealand.

Echinocyamus polyporus n. sp.

Arachnoides placenta (L.) — erroneous identification; = **Arachnoides zelandiæ** Gray.

Laganum depressum (Ag.). (?).

— *rostratum* Ag. — probably not New Zealand.

— sp. = **Peronella hinemoæ** n. sp.

Echinoneus ventricosus Ag. & Des. — not New Zealand.

Echinobrissus recens (M. Edw.).

Echinocardium australe Gray.

Metalia sternalis (Lmk.) — probably not New Zealand.

Brissopsis zealandiæ n. sp.

— *luzonica* (Gray) — not New Zealand.

The total number of Echinoids till now known with certainty from the New Zealand seas accordingly amounts to 19, five of these being here recorded for the first time. Most probably more thorough investigations, especially in the region off the North end of the North Island and round the Three Kings Islands will increase the number quite considerably. If the species from the deep-sea round the islands be included — which may, of course, be quite

legitimate — the list is notably augmented; but there is no reason to enter on the New Zealand deep-sea fauna at the present occasion.

The region of the South Island is not especially rich in Echinoids, and future researches can hardly be expected to yield many new forms from there. Still less are we to expect noteworthy additions to the littoral or sublittoral Echinoid-fauna of the Auckland-Campbell Islands, from which only one species, *Notechinus novæ-zealandiæ*, is known till now. In the deeper water off these islands we may, of course, expect to find a good deal more.

The zoogeographical relations of the New Zealand Echinoids will not be discussed in the present paper; this may be put off, till the whole of the Echinoderms has been worked out. I would only already now point out the fact that, excepting *Echinocardium australe*, which seems to be identical with *Echinocardium cordatum*, thus being almost cosmopolitan, and *Laganum depressum*, the identification of which is not beyond doubt, there is not one species known with certainty to occur outside the Australian-New Zealand region. Especially there is not one species common to New Zealand and the Magellanic or the Antarctic region.

From a morphological point of view no special interest attaches to any of the new species here described; in this regard *Arachnoides zelandiæ* and *Echinobrissus recens* range far beyond any of the new forms. Of no small interest is the observation that the tubercles of *Pseudechinus albocinctus* (and *Notechinus magellanicus*) show traces of crenulation. But the outstanding point is the discovery that **the young Echinobrissus has a well developed dental apparatus, which is absorbed before the animal reaches the adult size.** This discovery, together with that made by Westergren in 1909 of the existence of a dental apparatus in the young *Echinoneus*,[1]) is of very considerable interest, especially from a phylogenetic point of view, throwing important light on the relationship of the Cassidulids. Also from a physiological point of view the absorption of the perfectly developed and actually functioning dental apparatus,

[1]) A. Agassiz. On the existence of teeth and of a lantern in the genus Echinonëus van Phels. Amer. Journ. Sc. XXVIII.

resulting in the transformation of the dentate into an edentate animal, a transformation which is performed in a very short time, must claim considerable attention.

1. *Goniocidaris umbraculum* Hutton.

Pl. VI. Figs. 1–2.

Cidaris tubaria. Hutton. 1872. Catalogue of the Echinodermata of New Zealand, p. 10.

Goniocidaris umbraculum. Hutton. 1878. Notes on some New Zealand Echinoderms, with descriptions of new species. Trans. N. Z. Inst. XI. p. 306.

— — Farquhar. 1898. On the Echinoderm Fauna of New Zealand. Proc Linn. Soc. N. S. Wales. p. 316

— — Th. Mortensen. 1903. „Ingolf" Echinoidea. I. p. 24. Pl. X. Figs. 13, 21.

— — H. L. Clark. 1909. The Cidaridæ. Bull. Mus. Comp. Zool. 51. p. 198. Pl. 10. 3—4.

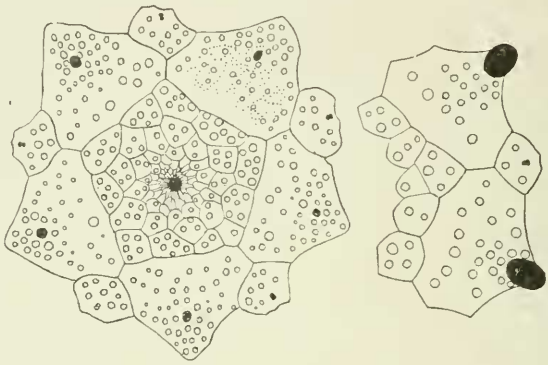
— — W. B. Benham. 1909. Scientific Results of the New Zealand Government Trawling Expedition. 1907. Echinoderma. Records of the Canterbury Mus. I. Nr. 2. p 23.

— — H. L. Clark. Report on the Sea-Lilies, Starfishes, Brittle-Stars and Sea-Urchins obtained by F. I. S. „Endeavour" on the coasts of Queensland, N. S. Wales, Tasmania, Victoria, S. Australia and W. Australia. Biol. Res. of the Fishing Experiments carried on by F. I. S. „Endeavour" 1909—14.

This species has never been adequately described. The characteristic, widened upper radioles were mentioned by Hutton and Benham, the pedicellariæ were figured by the present author, while Hutton and Clark give some remarks on the characters of the test, the latter author giving a pair of figures of a denuded test. It is not easy to get a good conception of the species from these scattered remarks and I therefore have thought it my duty to take this opportunity of supplying the lacking description and also to give a pair of figures of the species, in order to show its normal appearance. The material at my disposal consists of 4 specimens, preserved in alcohol, and 4 dried specimens, all apparently from the Foveaux Strait between New Zealand and Stewart Island; I am indebted for this material to Professor Benham, Otago, and to Captain Bollons, of the N. Z. G. S. „Hinemoa". Recently one

more specimen from the Cooks Strait was sent me from the Dominion Museum of Wellington. I did not myself find any specimens in the dredgings which I undertook at Stewart Island in 1914. The species has not been recorded from any other locality. There is no record of the depth in which it has been found, but it is evident that the species belongs to the sublittoral region.

The measurements of one of the largest specimens in hand are in mm: diameter 26, height 16, peristome 11, apical system 10,5. Width of interambulacra at the ambitus 8 mm, of ambulacra 3,5 —4 mm. The interambulacral plates number 9—10; there are 6



a. b.

Fig. 1. Apical system of *Goniocidaris umbraculum*. a. of a male specimen; 4/1. b. of a female specimen. 7,5/1.

ambulacral plates corresponding to each interambulacral plate at the ambitus, only 4—5 below the ambitus, and close to the peristome only 3. Test somewhat flattened above. There is a rather broad naked median space in the interambulacra, somewhat sunk; but it is not deeply grooved at the points where the horizontal and the vertical sutures join one another; there is no groove at the outer end of the horizontal sutures. The areoles are confluent on the oral side, sometimes unto the 6th—7th. The tubercles surrounding the areoles hardly larger than those of the rest of the tuberculated part of each plate; they hardly diminish in size towards the naked median part, contrary to what is the case e. g. in *G. geranioides*. The ambulacra have a fairly broad, naked, sunken median part. There is a single small tubercle close inside the primary tubercle on each plate, at the lower border; at the ambitus

the plate opposite the suture between each two interambulacral plates generally is higher than the rest of them and carries a tubercle, sometimes nearly as large as the primary one, at the outer edge, above the pores. There is only a very narrow ridge between the pores of each pair, hardly showing any elevation. Figures of the naked test have been given by Clark (The Cidaridæ, Pl. X. 3—4), to which may be referred.

The apical system nearly as large as the peristome. The oculars are all exsert. The outline of the plates may be seen from textfig. 1. The genital pores of the females are very large, situated at the outer corner of the genital plates; in the males they are much smaller and are situated a good distance from the edge. In both sexes they are covered by the surrounding spines, which stand much closer here than on the inner part of the plate. — The large female genital pores indicate that the eggs are large and yolky,[1]) which leads to the suggestion that this species may perhaps protect its brood as do so many other Cidarids of the antarctic and subantarctic regions. The peristome is almost without spines in the outer part, the plates being there rather high, and the ambulacral pores accordingly fairly distant. In the inner part the plates are very much lower, and the pores stand very close, the two series of each ambulacrum forming together a distinct arch at the mouth-edge. These inner plates are closely covered with spines.

The colour of the naked test is distinctly greenish on the aboral side.

The radioles are rather short, generally only $^1/_2$—$^3/_4$ of the diameter of the test; only in one of the specimens in hand they slightly exceed the diameter of test. The oral radioles are only little specialized, with slightly serrate edges; those at the ambitus generally have a pair of coarse blunt thorns at the base; they are slightly tapering, with somewhate serrate longitudinal ridges. The upper radioles are quite short, widened at the point into a flat or slightly concave disk, sometimes only small, sometimes very large (Pl. VI, Figs. 1—2). Intact radioles, not worn or covered by foreign organisms (as they generally are) are found to have, espec-

[1]) I have opened one of the alcoholic specimens and thus can assert that the eggs are really large and yolky; the exact size cannot be given, the preservation not being very satisfactory.

ially in the lower part, a coat of woolly, calcareous hairs. The radioles are generally slightly pinkish at the base.

The secondary spines are flattened, straight, slightly thickened at the point; those on the aboral side are of a faint greenish tint.

Figures of the pedicellariæ were given in my „Ingolf"-Echinoidea I, to which may be referred. It is to be noticed that the large globiferous pedicellariæ, which are rather scarce in number, are not placed on the naked, sunken part of the interambulacra, as they are in *G. geranioides* and *tubaria*, but at the edge of the tuberculated part, close to the horizontal sutures. They are rather unlike the peculiar globose pedicellariæ of the typical *Gonicidaris*-species. The stalk is not very short; it has no limb. Tridentate pedicellariæ have not been observed. — The spicules of the tube-feet do not afford marked specific characters. One tubefoot was found to offer the curious anomaly of having a small sidebranch, ending in a small disk like the main stem of the foot.

In his „Endeavour" Echinoderms (p. 104) H. L. Clark suggests that the Cidarid from Tasmania which he refers to *Goniocid. clypeata* Död. may perhaps be identical with *G. umbraculum*. Dr. Ch. Anderson, director of the Australian Museum, Sydney, having kindly sent me two specimens of the Tasmanian species I can positively assert that it is not identical with *G. umbraculum*. It is a much more delicate form, very closely resembling the Japanese *G. clypeata*, as stated by Clark. Whether it is really identical with that species I shall not try to decide here; also I must refrain at the present occasion from a discussion of the proper limits of the difficult genus *Goniocidaris*.

2. *Ogmocidaris Benhami* n. g. n. sp.

Pl. VI. Figs. 3—6; Pl. VII, Figs. 1—2.

Porocidaris elegans Agass. W. B. Benham. 1909. Scientif. Res. N. Z. G. Trawling Exped. 1907. Echinoderma. Rec. Canterbury Mus. 1. 2. p. 25.

This species, which was discovered by the New Zealand Goverment Trawling Expedition (the „Nora Niven" Expedition) was referred by Benham to *Porocidaris elegans* Agass. Professor Benham having kindly sent me two specimens of the species, thus affording me the opportunity of examining it, I must assert that it

is not at all identical with "*Porocidaris*" *elegans.*[1]) It represents not only a hitherto undescribed species but it must even be made the type of a new genus, though recalling in some important features the genus *Austrocidaris*, which is, apparently, its nearest ally.

No specimens were taken by myself during my cruises in the New Zealand seas, only some isolated radioles were found off White Island, 55 fms., undoubtedly belonging to the same species. Thus I have to base the description on the two specimens placed at my disposal by Prof. Benham, to whom I beg to offer my best thanks. I take the pleasure of dedicating this new species to him.

	Diameter.	Height.	Apical system.	Peristome.	Ambulacra Width.	Ambulacra Plates	Interambulacra Width.	Interambulacra Plates.	Longest radioles.
a.	20	11	10	8	2,5	33	9,5	6—7	—
b	19	10	9,5	8	—	—	—	6—7	30

The measurements are in mm. In specimen a. none of the longer radioles were intact; specimen b. is preserved as an alcoholic specimen and exact measurements of the ambulacral and interambulacral areas therefore cannot be given.

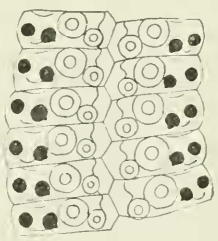


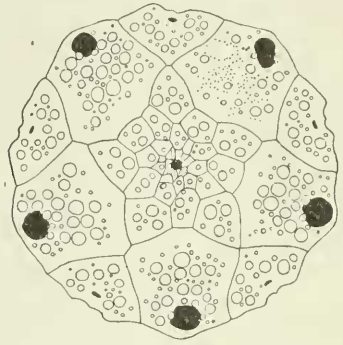
Fig. 2. Part of ambulacrum of *Ogmocidaris Benhami*. $^{8}/_{1}$.

The test (Pl. VI, Figs. 4—6) is flattened above and below, sligtly incurved at the oral edge, the peristome being somewhat sunken. Both ambulacral and interambulacral areas with a distinct sunken midline. The interambulacral plates number 6—7. The areoles are fairly deep, only the three, small, lower ones confluent. No crenulation. The scrobicular circle not very prominent, the tubercles of it being only slightly larger than those outside, which are few, close set; those towards the median side project irregularly into the sunken median

[1]) The correct name is *Histocidaris elegans* (A. Ag., in spite of Benham's rejection of the generic name *Histocidaris*. He did so, relying on Agassiz' declaration that my method — using the microscopic characters of the pedicellariæ as distinguishing characters of species and genera — was unscientific. I do not think anybody would venture to maintain this any more. But there is a bit of nemesis here. If Benham had taken the trouble to look at the pedicellariæ, he would at once have seen that this species could not possibly be identical with "*Porocidaris*" *elegans*.

area which is otherwise sharply limited, fairly broad, with a distinct corner at each horizontal suture. In the ambulacra (Fig 2) which are flush with the test, the naked, sunken median area is quite narrow, but sharply limited; on the oral side it is restricted to a small, but distinct, groove at each horizontal suture. Each plate carries a small tubercle at the lower corner inside the primary one, which latter is not very prominent. The pores are oblique, separated by an elevated wall.

The apical system (Fig. 3) is half h. d., flat. The oculars are exsert; however in specimen a. Oc. III, and in specimen b. Oc. IV



3.

4.

Fig. 3. Apical system of *Ogmocidaris Benhami*. 4/1. — Fig. 4. Oral radioles of *Ogmocidaris Benhami*. 8/1.

touches the periproct, while in both Oc. I very nearly reaches it. The genital plates have a nearly straight outer edge, the outline of the whole apical system is thus almost circular. The female genital pores are large, close to the outer edge of the plate. (Both specimens are females). The periproct is small, consisting of few plates only. The whole of the apical system closely covered with tubercles, excepting a fairly broad inner edge of the genital plates, which remains bare. The peristome is covered only with few plates, viz. 4—5 sparsely tuberculated ambulacral plates and 2—3 small, weak interambulacral plates, which are widely excluded from the mouth edge. The structure of the peristome upon the whole recalls that of the genus *Aporocidaris*.

The radioles are long, ca. 1 1/2 h. d., slender, slightly tapering. They are provided with finely serrated ribs, and the surface otherwise covered with short, simple hairs. The oral radioles (Fig. 4) are fairly distinctly serrated along the edges and may be slightly curved; when worn, the serrations may be quite obsolete. The secondary spines are fairly long, those round the radioles are flattened, the rest of them more or less distinctly cylindrical.

Only globiferous pedicellariæ are found (on the specimens in hand, at least). The larger ones (Pl. VIII, Fig. 1) have fairly elongate, narrow valves, with a very irregular, thorny meshwork on the inner side, below the opening. There is no endtooth. The stalk is simple, without a limb. The smaller forms (Pl. VII, Fig. 2) have a rather distinct endtooth. Possibly the larger forms, found in the material available, do not in reality represent the large globiferous pedicellariæ; this cannot be decided at present. But, at any rate, there are all transitions between the two forms figured. — Spicules of the tubefeet of the usual type.

Colour of the test slightly greenish on the aboral side; the radioles with a faint pinkish tint, mainly in their basal part.

The large genital pores indicate that this species has large eggs and probably protects its brood.

It seems fairly evident that this form is related to the genus *Austrocidaris*, with which it agrees in the characters of the sunken median area of the ambulacra and interambulacra. Also the structure of the pores and the radioles is the same. On the other hand it differs so markedly from that genus in the exsert oculars and the covering of the peristome, as also in the structure of the pedicellariæ, that it seems unjustifiable simply to refer it to that genus. The character of the peristome recalls the genus *Aporocidaris*, but the apical system is not of the character peculiar to that genus, and also the pedicellariæ are different. I do not see any other possibility than to establish a separate genus for it, the diagnosis of which is as follows:

Ogmocidaris[1] n. g. Test low, height only half h. d. Interambulacral plates 6—7; areoles rather deep. A sharply limited, naked,

[1] ὄγμος = furrow.

sunk median area in both ambulacra and interambulacra. Ambulacra ca. 1/4 the width of the interambulacra. 7—8 ambulacral plates corresponding to one interambulacral plate at the ambitus. Pores oblique, separated by an elevated wall. Apical system half the h. d., peristome somewhat smaller. Oculars mainly exsert. Plates of the peristome few, the interambulacral ones not reaching the mouth edge. Radioles long and slender, ca. 1 1/2 h. d. of test. Larger secondary spines flattened, the ambulacral ones nearly cylindrical. Large globiferous pedicellariæ (?) with elongate, flattened valves, without an endtooth; the small globiferous pedicellariæ with a distinct endtooth. Tridentate pedicellariæ (apparently) wanting.

3. *Cidaris* sp., juv.

One more species of Cidarids occurs in the New Zealand seas. In a dredging 10 miles N. W. of Cape Maria v. Diemen, 50 fms. (5/1 1915) I found a single specimen of a very young Cidarid which is easily seen to be entirely different from the two other New Zealand Cidarids.

Fig. 5. Radiole of *Cidaris* sp. 20/1.

The said specimen is 3 mm in diameter. There are 5—6 plates in the interambulacral series. No naked, sunk median line. The radioles (Fig. 5) are short, the upper ones only 2 mm long. They are very sharply and coarsely thorny along the edges; also on the aboral side there may be a distinct series of similar thorns, while the adoral side is nearly smooth. Secondary spines very few and small. Some few small globiferous pedicellariæ are found on the peristome. They have no endtooth (Pl. VIII, Fig. 3). The colour of test and radioles is white; the apical system is faint greenish.

It is quite impossible to identify this young Cidarid with certainty, since its specific characters are not yet fully developed. The character of the radioles would seem to indicate that it is a new species (— of course, the radioles described above are fully formed ones, as is evident from the existence on them of the ostracum-layer —). It is no use trying to trace out its relations, which could, at present, be nothing but guess-work; we must wait for more material. But the characters noted above will suffice for recognizing the species, when more material comes to hand. The rather

large number of coronal plates developed already at this young age (— the genital pores have not yet appeared —) indicates that it is a form of small size.

4. *Aræosoma thetidis* (H. L. Clark).

Asthenosoma thetidis H. L. Clark. 1909. Notes on some Australian and Indo-Pacific Echinoderms. Bull. M. Comp. Zool. LII. p. 134.

Arœosoma — A. Agassiz & H. L. Clark. 1909. Hawaiian & other Pacif. Echini. Echinothuridæ. Mem. Mus. C. Zool. XXXIV. p. 176. Pl. 66, figs. 6–17. Pl. 68-70.

— — H. L. Clark. 1916. „Endeavour" Echinoderms. p. 107.

Astropyga radiata F. Jeffr. Bell. 1917. British Antartic („Terra Nova") Exped. 1910 Zoology. Vol. IV. 1. Echinoderma. p. 6.

This species was dredged by the "Terra Nova" Expedition 7 miles E. of North Cape, 70 fms. It was not taken in my own dredgings in the sea to the North of New Zealand, but having had the opportunity of examining the "Terra Nova" specimens in the British Museum I can positively assert that the "identification" of them by Bell as *Astropyga radiata* is wrong. The merest glance at the specimens shows that they are Echinothurids, and on a closer examination they are easily seen to be identical with the Australian *Arœosoma thetidis* (H. L. Clark).

To the description of this species, given in the works quoted, I may add that in the New Zealand specimens I have found the "dactylous" (globiferous) pedicellariæ, which Clark did not find in the Australian specimens. They are three-valved and hardly distinguishable from those of *A. Owstoni* Mrtsn.

5. *Notechinus novae-zealandiæ* n. sp.

Pl. VI. Figs. 7—10; Pl. VIII. Figs. 4—5, 7—11.

Echinus angulosus Farquhar. 1898. Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. p. 319.

— — Benham. 1909. Scient. Res. N. Z. G. Trawling Exped. 1907. Echinoderma. Rec. Canterbury Mus. I. p. 25. Pl. XI, Fig. 5.

In my Report on the Echinoidea of the Swedish South Polar-Expedition[1]) I called attention (p. 40, Note 2) to the fact that the

[1]) Wissensch. Ergebn. d. Schwed. Südpolar Exp. 1901—3. Bd. VI. 1910.

Echinus angulosus, recorded from New Zealand by Benham (and Farquhar), has nothing with that species to do but represents a new species of the genus *Notechinus*. For want of sufficient material I did not then characterize and name the species. Having now partly myself collected some specimens of this species, partly received some more specimens from Mr. W. R. B. Oliver and from Captain Bollons I here give the description of this new form.

Diameter.	Height.	Apical system.	Peristome.	Ambulacra Width.	Ambulacra Plates.	Interambulacra Width.	Interambulacra Plates.	Longest spines.
mm	mm	mm	mm	mm		mm		mm
40	27	7	12	9	33—34	14	22—23	7
32	18	5,5	11,5	8	30—31	11,5	20	5
24	15	6	9,5	6	22	8	15	6
17	9	4	7	4	22	5,5	15	4
13	7	3	5	3,5	15	4,5	12	3

The shape of the test is fairly regularly hemispherical, the oral side being flattened, slightly sunken at the peristome. The circumference is round; in one specimen the interporiferous area of the ambulacra slightly prominent.

The primary tubercles of the ambulacra form very regular, close series; on the oral side they stand so close together that they must be said to be confluent, being separated only by a quite narrow ridge, without any room for even the smallest tubercle; on the aboral side they are less close, some few miliary tubercles being found between them, but in the larger specimens they are generally confluent nearly throughout the whole ambulacrum, so that only between a few of the uppermost tubercles a series of miliary grains (carrying pedicellariæ) may be found. In the larger specimens the boss of the tubercle is not quite round, being distinctly cut off at the edge turning against the lower pore of the corresponding plate (Fig. 6). The median area is narrow, closely covered by secondary and military tubercles, the former being about half the size of the primary ones and forming a pair of distinct longitudinal series. Some small secondary tubercles are found also among the pores.

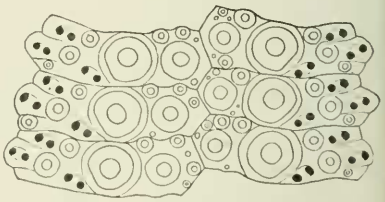


Fig. 6. Part of Ambulacrum of *Notechinus novæ zealandiæ*. 6/1.

In the interambulacra the are-

oles of the primary tubercles are confluent on the oral side, but not above the ambitus, even in the larger specimens. The secondary tubercles are generally rather large, almost as large as the primary ones; they form, inside the primary series, one very distinct, nearly complete series, and, at the ambitus, a second series, shorter or longer, according to the size of the specimen. Outside the primary tubercle there are at the ambitus in the larger specimens one or two transverse series consisting each of two larger secondary tubercles, plates with one or two such series alternating more or less regularly. These outer secondary tubercles do not form very regular vertical series. On the plates with only one series of outer secondary tubercles the primary and secondary tubercles together form a very distinct horizontal series throughout the whole breadth of the plate; in those plates which have a double series of outer tubercles the transverse series is less regular. The interambulacral areas upon the whole are very closely covered by the tubercles, no naked median space being left.

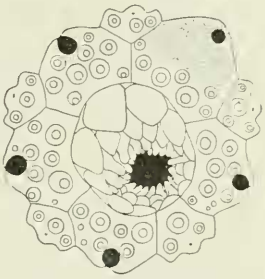


Fig. 7. Apical system of *Notechinus novæ-zealandiæ* The periproct slightly reconstructed, (the part off Ocular I.) $^6/_1$.

The apical system (Fig. 7) is remarkable through its small size, occupying, in the larger specimens, scarcely more than $^1/_6$ of the h. d. The genital and ocular plates are generally closely tuberculated; Ocular I is insert. The madreporite is distinctly elevated. The periproct is somewhat oblong, the anal opening being excentrical, situated more or less close to the edge, off Oc. I; there is a more or less complete circle of outer, larger plates, the one opposite the anal opening (adjoining Genital III), representing the anal plate, being somewhat larger than the rest. They are all thick and somewhat elevated, all perfectly naked. Inside the outer circle are some small, generally somewhat elongated plates, surrounding the anal opening. In the largest specimen some smaller plates have appeared outside the circle of larger plates, the anal plate thus being separated from the edge of the periproct.

The colour of the test is of a uniform grey, with a slight greenish tint;[1]) the pore areas and the tubercles are white.

The spines are very short, rather coarse, forming a dense, uniform coat. They are dark green, more or less distinctly white-tipped, or sometimes with a faint indication of violet at the tip. The spines at the edge of the peristome not curved. The secondary spines generally somewhat darker than the primary ones; they are slightly thickened at the point.

The peristome is entirely naked as in *N. magellanicus*, hardly with a single bihamate spicule, while such spicules are found numerously in the gills. The buccal plates carry numerous ophicephalous and triphyllous pedicellariæ but apparently no tridentate ones.

The tubefeet with only very few bihamate spicules or entirely without any spicules.

Pedicellariæ. The globiferous pedicellariæ are of two kinds, as in *N. magellanicus*, a larger and a smaller form, both with double poison glands. The valves of the larger form (Pl. VII, Figs. 4—5) are rather short and robust, with 1—2, more rarely 3, teeth on each side of the blade. The small form (Pl. VII, Figs. 7—8) has only one tooth on each side. The small form is found in great numbers in the larger specimens, while in the smaller specimens they are very scarce. The tridentate pedicellariæ (Pl. VII, Fig. 9) are small and inconspicuous; the valve is narrow, with a slightly widened smaller or larger end part with finely serrate edges. Ophicephalous and triphyllous pedicellariæ (Pl. VII, Figs. 10—11) offer no features of special value as specific characters. The same holds good of the sphæridiæ.

One of the specimens (the smallest, 13 mm h. d.) is infested with a parasitic snail, three specimens of which are found attached at the border of the peristome.

Of this species I collected one specimen myself in Paterson Inlet, Stewart Island, at a depth of 10—30 meters. A few more specimens, dredged in the Foveaux Strait at ca. 40 meters depth, were given to me by Captain Bollons, as also one from off the

[1] The colour of test and spines is rather similar to that of *Parechinus angulosus*, which explains the identification with that species.

East coast of the South Island, from a depth of ca. 40—100 meters. Further two large specimens, taken at Shag Point, Otago, under stones at low water, were given me by Mr. W. R. B. Oliver (Auckland). These localities, together with those given by Farquhar and Benham, tend to show that in New Zealand this species is confined to the seas round the South Island, the most northern locality, from where it is recorded, being Cape Campbell, at the entrance of the Cooks Strait. While thus it does not appear to occur to the North of the Cooks Strait, I can give evidence of its being further distributed in the southern seas of the New Zealand region.

During my trip to the Auckland- and Campbell-Islands I was very anxiously looking out for Echinoids. Although not one Echinoid was found there by the New Zealand Expedition, the occurrence of at least one species at the Campbell Island has been established by Filhol, who records *Echinus margaritaceus* from Perseverance Harbour. That this identification was wrong could hardly be doubted, but the specimens having apparently been lost (Comp. my Report on the Echinoidea of the Swedish South Polar Exped. p. 50) it could not be ascertained, which species it really was that he had found there. To my great disappointment my dredgings in the Perseverance Harbour did not yield a single specimen of any Echinoid, and neither did I find any at the Auckland Islands. I was then most agreably surprised in receiving later on from the (now late) chief engineer of the „Amokura", Mr. Pyke, a specimen of an Echinoid which he had got at the next visit of the „Amokura" to the Campbell Island from the shepherds living at Perseverance Harbour, and which had been found thrown up on the beach in the inner part of Perseverance Harbour. It proved to be a young specimen of *Notechinus novæ-zealandiæ*. There is then every reason to suppose that this was the species, which Filhol mistook for „*Echinus margaritaceus*". It may thus be expected that this species will also be found at the Auckland Islands. Further I can state that it occurs likewise at Macquarie Island. At the Dominion Museum of Wellington I was told by Mr. Hamilton that, during his visit there with the Australian Antarctic Expedition (1911—13) he had found a pair of sea-urchins cast up on the rocky shores; the specimens, which were kindly submitted to me, proved to be likewise *Notechinus novæ-zealandiæ*. — From a zoo-

geographical point of view the occurrence of the species at the Campbell and Macquarie Islands seems very natural.

Among the specimens which I received from Captain Bollons there is one specimen from off the East Coast of the South Island of New Zealand, ca. 40—100 meters, which differs rather conspicuously from all the other specimens and cannot simply be identified with them (Pl. VI, Fig. 16). It is distinctly higher than the other specimens, 19 mm high, by 28 mm h. d. There are 25 ambulacral plates and 17 interambulacral plates in a series. The apical system is 6,5 mm, the peristome 9 mm. The arrangement of the tubercles is as in the typical form, but they are upon the whole hardly so large as there. The most conspicuous difference from the typical form is the colour of the test which is a uniform reddish-green. Also the globiferous pedicellariæ differ from those of the typical form in the blade of the larger form being longer and more slender (Pl. VII, Fig. 6). The tubefeet contain fairly numerous bihamate spicules. — This specimen shows the remarkable abnormality that Genital IV (or Ocular V?) is divided into two plates (Fig. 8).

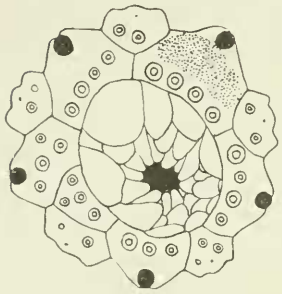


Fig 8. Apical system of *Notechinus novæ-zealandiæ*, var. Slightly abnormal. 5/1.

On account of these differences in the shape and colour of the test, and in the large globiferous pedicellariæ, it seems to me unjustifiable simply to unite this form with the typical form. Possibly it represents a distinct species. On the base of the single, dried, not very well preserved specimen in hand, I do, however, not venture to establish it as a separate species but shall prefer, until more and better material is available, to regard it as a variety only of *N. novæ-zealandiæ*.

This new species of the genus *Notechinus* is easily distinguished from *N. magellanicus* through several characters, especially the colour of both test and spines, the much smaller size of the apical system and the, generally, distinctly larger number of plates (as seen by a comparison of the table, given above, with that of

N. magellanicus, given in my report on the Echinoidea of the Swedish South Polar Expedition, p. 37). Also the tuberculation is rather different in the two species, especially the primary ambulacral tubercles are much less confluent in *N. magellanicus* than in the present species. Finally the large globiferous pedicellariæ are conspicuously different in the two species.

The Var. *novæ-amsterdamiæ* Döderlein of *N. magellanicus* would appear to stand nearer to the New Zealand species than to the typical form of *N. magellanicus*, this variety being distinguished by its greater number of ambulacral plates and the smaller size of its apical system. Döderlein (Echinoideen d. Deutschen Tiefsee-Expedition p. 230) gives for a specimen of 22 mm h. d. 18 interambulacral and 26 ambulacral plates. In a specimen of 25 mm h.d. which I have received from Prof. Döderlein, I find 22 ambulacral and 16 interambulacral plates; the apical system is only 5 mm in diameter. It is evident that in these regards this variety is more in conformity with the New Zealand species than with the typical *N. magellanicus*. But then the colour of the test is distinctly reddish as in *magellanicus*, although lighter, as stated by Döderlein, and the globiferous pedicellariæ are notably slenderer than in the New Zealand species. The var. *novæ-amsterdamiæ* thus occupies an intermediate position between the two species, but is distinctly different from both. I should, indeed, be more inclined to regard it as a separate species.

The discovery of a new species of this hitherto monotypic genus is of considerable interest from a classificatory point of view, giving additional proof that Döderlein was perfectly right in establishing a separate genus for the species *magellanicus*; the occurrence of two kinds of globiferous pedicellariæ in this genus is especially interesting; the fact that both species agree in this feature shows that it is a character of real value. Also from a zoogeographical point of view it is of considerable interest to find this genus represented by related species in the New Zealand and the South American seas.

6. *Pseudechinus albocinctus* (Hutton).

Pl. VI. Figs. 11–15; Pl. VII. Fig. 24.

Echinus albocinctus. Hutton, 1882. Catalogue Echinod. New Zealand, p. 12.
— *magellanicus* Hutton, 1876. Trans. N. Z. Inst. IX. p. 362.
— — Farquhar. 1898. Echinoderm Fauna of N. Zealand, p. 320.
Pseudechinus albocinctus. Th. Mortensen, 1903. Ingolf-Echinoidea. I. p. 104, 106, 178; Pl. XIX. Figs. 19, 25.
Echinus — P. de Loriol. 1914. Notes pour servir à l'étude des Echinodermes. 2. Ser. II. p. 18. Pl. I. Figs. 10. a–c.
Pseudechinus — Döderlein. 1906. Echinoiden d. deutschen Tiefsee-Exped. p. 231, Taf. XXIX, 5; XXXV, 5; XLVI, 8.
— — Benham. 1908. An erroneous Echinodermal identification. Ann. Mag. Nat. Hist. 8. Ser. I. p. 107.
Echinus — — 1909. Echinoderma. N. Z. G. Trawling Exped. p. 27.

Of this fine species, hitherto so poorly represented in the collections of the various Museums, I have been fortunate to secure a rich material, partly from Stewart Island, partly from Queen Charlotte Sound, in which latter locality it was very common. I then take the opportunity of giving some figures of this species, the only figures existing (Loriol, loc. cit., Döderlein, loc. cit.) not being very satisfactory, though especially the latter is by no means bad.

It seems unnecessary to give a complete description of the species, the descriptions found in the works quoted giving sufficient information of its specific characters. Only some measurements must be given. Also a few remarks are to be made.

Diameter.	Height.	Apical System.	Periproct.	Peristome.	Ambulacra		Interambulacra	
					Width.	Plates.	Width.	Plates.
mm	mm	mm	mm	mm	mm		mm	
37	25	8,5	4	13	8,5	27–28	14,5	19–20
35	20	8	3	13	7	25—26	13	18
32	19	8	3,5	12	7	22	13	16—17
31	19	8	3	11,5	7	22	13	16
30	16	7,5	3	10,5	7	20—21	12	16
30	17,5	7,5	3	11	7	23—24	12	16
15	8,5	4,5	2,5	6	—	15—16	—	12
8	4	3	1,5	3,5	—	11	—	11
4	3	2,2	1	2,5	—	9	—	9

To the description of the tuberculation should be added that the areoles of the primary tubercles in both ambulacra and interambulacra are confluent on the oral side, generally unto the ambitus.

A remarkable feature is observed on the tubercles, viz. a sort of fine crenulation, produced by a circle of dark coloured grains along the edge of the ring (or the „parapet of the platform" in the Terminology of Bather „Triassic Echinoderms of Bakony", 1909, p. 61). This may probably have nothing to do with genuine crenulation, but, at any rate, it is well worth noticing. The same feature is to be observed in *Notechinus magellanicus*, but not in *N. novæ-zealandiæ*.

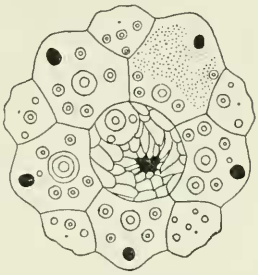


Fig. 9. Apical system of *Pseudechinus albocinctus*. 3,8/1.

Döderlein states that one Ocular is insert. The single specimen which he has examined must have been exceptional in this regard; in my material I find only very rarely Oc. I just touching the periproct; the rule is that all Oculars are exsert. As a rule there is only one primary tubercle at the inner edge of each genital plate, besides some secondary tubercles. The periproct is small (comp. measurements) and affords a very characteristic specific mark in the anal plate carrying one rather large tubercle; only very rarely it is lacking. Sometimes also a few of the other periproctal plates carry a tubercle (Fig. 9).

Regarding the peristome Döderlein maintains that it is not quite naked, as stated by Loriol and myself. Here again the specimen studied by Döderlein must have been exceptional. It is a rule that the peristome is quite naked, all my specimens are devoid of plates in the peristome, except of course the buccal plates. One specimen only presents the interesting abnormality that in one radius the buccal plates have been reduplicated, a pair of supplementary plates, each carrying a tubefoot, lying outside the primary pair, one of them close to the latter, the other nearer the edge of the peristome. Also the primary pair of buccal plates in this radius is slightly abnormal, the right plate being divided into two and devoid of a tubefoot. On this plate a sphæridia is found in the usual dense covering of ophicephalous and triphyllous pedicellariæ.

Regarding the pedicellariæ a few facts may be stated. The globiferous pedicellariæ have double glands. I find that valves with a tooth only on one side and such, having a small one also on the other side, are found almost equally often. In some cases I have found globiferous pedicellariæ with smaller head and longer stalk than the usual ones; but they are otherwise alike, and there is no such conspicuous difference between them, that one can distinguish between two different kinds of globiferous pedicellariæ as in *Notechinus*. Among the ophicephalous pedicellariæ some have much longer valves (Pl. VIII. Fig. 24) than others. It is evidently such an elongated form which has been figured by Döderlein (Op. cit. Taf. XLVI, Fig. 8. i) under the name of a tridentate pedicellaria.

No spicules are found in the tubefeet. The gills contain a fair number of delicate, fenestrated plates.

The specimens from Stewart Island have, upon the whole, a more reddish colour on the primary spines, which are also rather shorter than in the specimens from Queen Charlotte Sound. The difference is, however, so unimportant that it is hardly necessary to speak of these forms as local variations. The smallest specimens in hand, 7—10 mm h. d., have the basal part of the primary spines more greenish-brown, while in the larger specimens the colour is purple, which, together with the white tips, makes this species one of the most beautiful Echinoids.

The species has not been recorded from farther North than Wanganui (de Loriol, Op. cit.), and thus appears to be mainly confined to the region from Cooks Strait to Stewart Island.

H. L. Clark (Hawaiian a. o. Pacific Echini. The Pedinidæ . . . Echinidæ . . ., p. 274) [1]) has come to the result from the study of some bare tests of *albocinctus*, that it cannot be distinguished from *Notechinus* (or, as he names it, *Parechinus*) *magellanicus*; at most, he will concede to it the rank of a variety of the said species. In the test he cannot find any differences between the two forms, and the distinguishing characters, afforded by the globiferous pedicellariæ, he disregards. I agree, of course, that when naked tests of the two species are compared, the general resemblance is strik-

[1]) Mem. Mus. Comp. Zool. XXXIV, 1912.

ing, especially because the coloration of the test is so very alike. In the tuberculation there is certainly no very great difference, though especially the primary interambulacral tubercles on the oral side are more distinctly confluent (and not separated by miliary tubercles) in *albocinctus* than is the case in *magellanicus*. But then the apical system affords striking differences, the genital and ocular plates of *magellanicus* being covered by numerous tubercles, while in *albocinctus* they carry only one single larger tubercle and some few miliaries. Oc. I is insert in *magellanicus*, exsert in *albocinctus*; the anal plate is naked in *magellanicus*, while in *albocinctus* it carries one prominent tubercle. Also the size of the apical system and the periproct is different, being distinctly smaller in *albocinctus* as seen from the measurements of *albocinctus* given here, compared with those of *magellanicus* given in my Report on the Echinoidea of the Swedish South Polar Exped. p. 37. Then the colour of the spines is strikingly different and finally, in spite of the doubt expressed by Clark as to the constancy of the characters of the pedicellariæ (without his having had the opportunity of studying them himself), the globiferous pedicellariæ are distinctly different, both in the structure of the valves and through the fact that in *magellanicus* there are two different kinds of these pedicellariæ, in *albocinctus* only one kind.

There can thus not be the slightest doubt that *albocinctus* is quite distinct from *magellanicus*. Whether it is also correct to place the two species in different genera, is not so certain. The only essential difference between the two genera, *Notechinus* and *Pseudechinus*, is, in fact, that of the globiferous pedicellariæ. Since I have now found, on the rich material now at my disposal, that the occurrence of a tooth on both sides of the blade in *albocinctus* is by no means so very exceptional, I agree that the distinction is not very sharp. However, I think it advisable to retain the two genera for the present, especially in view of the fact that we know now at least two distinct species of each of them, which are both in perfect conformity, as regards the said characters of the pedicellariæ. The final proof of the validity of the two genera must be afforded by the study of their larvæ. If the larvæ prove to belong to the same main type I would hardly think the distinction of the two genera maintainable. In that case *Notechinus* becomes a syno-

nym of *Pseudechinus*, which latter name is the older and must be retained. To refer *albocinctus* and *magellanicus*, with their allied species, to the genus *Parechinus* (or *Protocentrotus*), as is done by H. L. Clark, is out of question, the plated buccal membrane and the quite different type of the globiferous pedicellariæ being too important characters to be disregarded. Perhaps also the "crenulation" may prove a character of importance. Whether there is in reality any nearer relation between *Parechinus* (*Protocentrotus*) and *Pseudechinus* the study of their larval forms may disclose.

7. *Pseudechinus Huttoni* Benham.

Pl. VI. Figs. 17—19; Pl. VII, Figs. 12—18.

Salmacis globator.[1]) Hutton, 1878 Notes on some New Zealand Echinod. Trans. N. Z. Institute. XI. p. 306.
— — Farquhar, 1898. Echinoderm Fauna of New Zealand, p. 318.
— — Hutton, 1904. Index Faunæ N. Zealandiæ. p. 288.
Pseudechinus Huttoni. Benham. 1908. An erroneous Echinod. identif. Ann. Mag. Nat. Hist. 8. Ser. I. p. 104.
Echinus — — 1909. Echinoderma N. Z. G. Trawling Exp. Rec. Canterb. Mus. I. 2. p. 27.

To Professor Benham is due the credit of having assigned this form, so long mistaken for *Salmacis globator*, to its true position,[2]) within the genus *Pseudechinus*; the fact that he was later on scared by the authority of A. Agassiz to disavow himself and to declare the microscopical characters of no value for distinguishing genera, and therefore put it into that old lumber-room, the "genus" *Echinus*, does not deprive him of the honour of being the first to apprehend this interesting species correctly.

To the very careful description, given by Benham, only some

[1]) Studer. Übersicht über die während d. Reise S. M. S. Corvette Gazelle um die Erde 1874—76 ges. Echinoidea. Monatsber. Akad. d. Wiss. Berlin, 1880, p. 874) quotes the name wrongly as *Arbacia globator.*

[2]) Provided the crenulation of *Ps. albocinctus* is not genuine, in which case the present species, in which no such crenulation is to be observed, could hardly be congeneric with the former. In that case it would represent a new genus.

few remarks need to be added; but figures and measurements, which have not hitherto been given, are to be supplied here.

Diameter. mm	Height. mm	system. mm	Periproct. mm	Peristome. mm	Amb. plates.	Lamb. plates.	Spines. mm
56	42	13	6,5	16,5	35	24—25	10
50	36	12	6	13,5	36—37	26—27	—
50	38	12	6	15	27—28	20	—
49	35	12	6	13	33	26	6
40	30	9	4,5	13	30—31	22	6
39	27	9	4,5	14	27—28	21	9
31	21	7	4	12	27—28	23	—

As seen by these measurements, there is a considerable variation in shape as well as in the number of plates, as exemplified to a striking degree by the two specimens of 50 mm h. d. — When, moreover, the colour is different, one having the characteristic pink tubercles with a slight greenish and pinkish tint on the middle of the plates, the other being perfectly white on test, tubercles and spines, one would be inclined to think them to be two distinct species. But as there are all transitional forms, and especially the very characteristic arrangement of the tubercles being the same, it must be conceded that they belong to the same species, which is, however, somewhat more than usually variable.

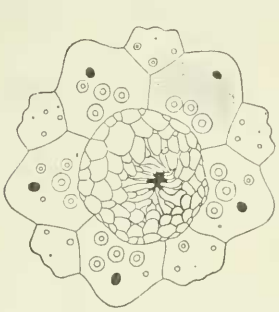
Concerning the tuberculation, attention may be called to the rather conspicuous feature that on the oral side the confluent areoles of the tubercles in the same transverse row produce slightly elevated, v e r t i c a l, separating walls. In the ambulacra also such horizontal walls are found, while in the interambulacra the transverse series of the consecutive plates are far from one another and separated by miliary tubercles, excepting only two or three of the lowermost plates. "Crenulation" as that seen in *albocinctus* is not observed.

The peristome is rather variable in size: it is perfectly naked, excepting the buccal plates which are covered with a dense coat of ophicephalous pedicellariæ with a few triphyllous ones among them.

The apical system (Fig. 10) is rather naked, sometimes distinctly elevated; the genital plates generally carry only three larger tubercles, close to the inner edge, and a very few miliary tubercles. Ocular I is generally broadly insert; in one case, in an otherwise

quite typical specimen, it is exsert. The anal area is covered by numerous small plates, among which the central plate is hardly distinguishable; it is sometimes provided with a small tubercle. In one specimen the very curious anomaly, shown in fig. 11, is observed. In another, large specimen the madreporite occupies both Gen. 2 and 3.

The spines round the peristome straight or only very slightly curved. The miliary spines somewhat thickened in the point, often



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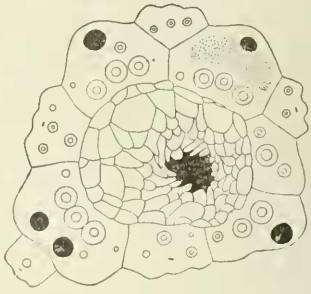


11.

Figs. 10—11. Apical system of *Pseudechinus Huttoni*. Fig. 11 shows the anomaly of Genitals 4 and 5 having coalesced so as to push Ocular V entirely out of its normal place. On the other hand Genital I is divided into two parts.
Fig. 10. 2,6/1. Fig. 11. 6/1.

also slightly swollen below the point (Pl. VII, Fig. 17). (In *Ps. albocinctus* they are hardly so much widened at the point.)

The pedicellariæ (Pl. VII, Figs. 12—16, 18) agree very closely with those of *Ps. albocinctus*; it is however, to be emphasized that in the present species the globiferous pedicellariæ appear to have constantly the lateral tooth developed only on one side. As in *albocinctus* elongate ophicephalous pedicellariæ are found, which form a transition to the tridentate type. — Spicules are found only exceptionally in the tubefeet. The gills contain numerous fine irregularly branched or fenestrated plates.

Regarding the colour, Benham states that, though some specimens have white spines, all have the tubercles pinkish orange. I find, however, that in some specimens also the test and the tubercles are perfectly white — even so in a specimen which I have received from Benham himself and which is otherwise

quite typical. The exquisite and characteristic pinkish coloration of spines and tubercles is accordingly no reliable specific character.

Two specimens of this species were dredged in Paterson Inlet, Stewart Isl., in 10—30 meters $^{17}/_{XI}$ 1914. Further several specimens were given me by Captain Bollons, who had dredged them off the East coast of the South Island in depths of ca. 40—100 meters.

The species appears to be confined to the seas off the South Island of New Zealand.

It seems evident that the species described by H. L. Clark in his Report on the Echinoderms of the „Endeavour" (p. 111, Pl. XLI, Figs. 1—3) under the name of *Parechinus notius* is very nearly related to *Ps. Huttoni*, representing an Australian form of the genus *Pseudechinus*. That it has no nearer relation to the genus *Parechinus* is evident from the characters of its buccal membrane (perfectly naked, excepting the buccal plates) and the globiferous pedicellariæ (carrying a lateral tooth only on one side of the blade). That it is distinct from *Ps. Huttoni* would appear from the character of the apical system (all oculars excert), the different colour of the test (pale brown) and the shape of the ophicephalous pedicellariæ (valves not at all constricted).

It is of considerable interest that this genus, otherwise known only from the New Zealand seas, thus has a representative also in the Australian seas (off the S. E. coast).

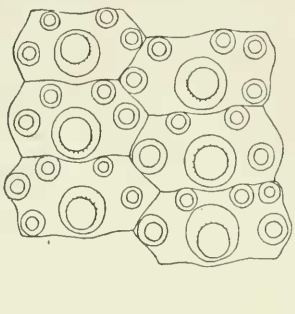
8. *Pseudechinus variegatus* n. sp.

Pl. VI. Figs. 20—21; Pl. VII. Figs. 19—23.

In some dredgings off the North of New Zealand a few small Echinoids were taken which, evidently, represent a new species of the genus *Pseudechinus*. Unfortunately all the specimens are immature, so that an adequate description of the species cannot be given; but the characters shown by the specimens available will, I think, suffice for recognizing the species, so that I have thought it justifiable to establish the species, in spite of the insufficient material.

Diameter. mm	Height. mm	Apical system. mm	Anal area. mm	Peristome. mm	Number of plates Ambulacra.	Lambulacra.	Longest Spines. mm
8	4,5	2,5	1	3,5	12—13	12	1,5
6,5	4,5	2,2	1	3	11	10	2

The test is low, as in *albocinctus* of corresponding sizes (comp. measurements). The tuberculation is rather coarse; the secondary tubercles are considerably smaller than the primary ones, but fairly numerous, leaving no naked median space, while in specimens of a corresponding size of *albocinctus* they are as yet few, the median



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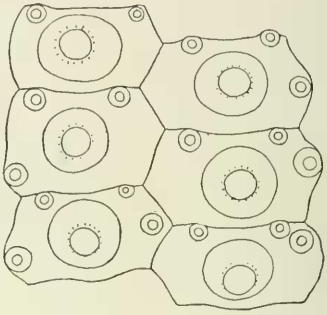

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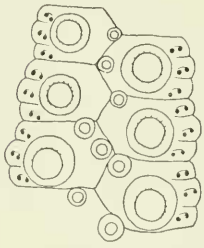

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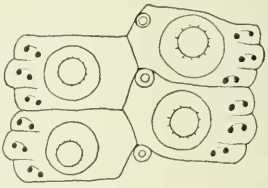


15.

Figs. 12–13. Interambulacra of *Ps. variegatus* (12) and of a young *Ps. albocinctus*, of 8 mm diameter (13). $^{15}/_{1}$.

Figs. 14–15. Ambulacra of *Ps. variegatus* (14) and of a young *Ps. albocinctus*, 8 mm (15). $^{15}/_{1}$.

part of both areas remaining bare. The arrangement of the secondary tubercles is somewhat irregular and does not convey the impression that the tubercles of the adult specimens will form transverse series. There is a faint indication of the same sort of crenulation as in *albocinctus*. (Figs. 12–15).

Each genital plate carries one prominent tubercle at the inner edge. All the oculars are exsert, but Oc. I reaches fairly near to the edge of the periproct, which appears to indicate that in the adult specimens it may be insert. The central plate is large, smooth.

The anal opening is excentric, close to the edge (Fig. 16). In the specimen of 6,5 mm h. d. the genital openings have just appeared, in that of 8 mm h. d. they have apparently not yet begun to form. A darker coloured (green or reddish) spot is found on each genital plate on the place of the future genital pore (or just outside it). Otherwise the genital and ocular plates are white, the periproctal plates green.

The test is somewhat variegated, white with green or greyish-green spots. The tubercles are white or greyish-green.

The spines are short, only $^1/_3$ or $^1/_4$ of the h. d., hardly tapering towards the point, which has a small central thorn; at the edge of the peristome they are distinctly widened, almost clubshaped, slightly curved. They are white, more or less distinctly banded with redbrown. The secondary spines (Pl. VII. Fig. 20) are conspicuously widened at the point, sometimes also widened below the point as in *Ps. Huttoni.*

The peristomial membrane, as well as the tubefeet, contain some bihamate spicules, the gills are richly provided with delicate, fenestrated plates and more or less irregular spicules.

The pedicellariæ (Pl. VII, Figs. 19, 21—23) in the main as those of *albocinctus*; no samples of globiferous pedicellariæ with a lateral tooth on each side of the blade were observed, nor have I found the large form of ophicephalous pedicellariæ.

The species was found at Three Kings Isl., 65 fms. (2 specimens) and 10 miles N. W. of Cap Maria van Diemen, 50 fms. (1 specimen) $^5/_1$ 1915. Further two specimens, dredged W. of Cuvier Isl., 35 fms., were received from Captain Bollons.

One of the specimens from Three Kings Isl. is infested with a parasitic organism, which may be a Gastropod; but the preservation does not allow determining with certainty what it really is.

This species evidently is nearest related to *Ps. albocinctus*, but it differs so conspicuously from it in the tuberculation, the size and shape of the spines and in the colour of test and spines that it is out of question that they could be identical. Also it is noteworthy that the genital openings have begun to form in a specimen of 6,5 mm of *variegatus,* while in *albocinctus* they have not begun to form in a specimen of 8 mm h. d. and, apparently, have only just been formed in a specimen of 15 mm h. d. This would appear

to indicate that *variegatus* is, upon the whole, of smaller size than *albocinctus*. — With *Ps. Huttoni* this species is, evidently, more distantly related.

9. *Pseudechinus grossularia* (Studer).

Amblypneustes grossularia. Studer. 1880. Übersicht d. während d. Reise S. M. S. Gazelle 1874—76 ges. Echinoiden Monatsber. d. Akad. d. Wiss. Berlin. p. 873. Taf. I. 5.

— — Th. Mortensen. 1904. The Danish Exped to Siam 1899—1900. Echinoidea. I. Kgl. Danske Vid. Selsk. Skr. 7. R. I. p. 105. Pl. VI. 21, 33; Pl. VII. 13, 52.

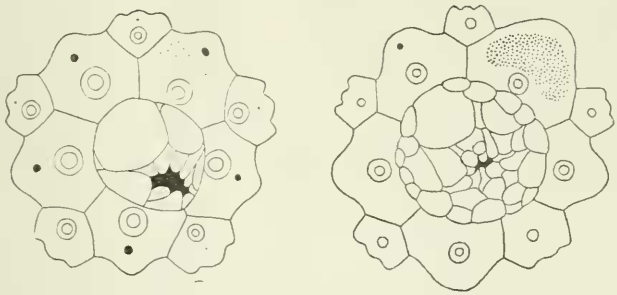
— — H. L. Clark. 1912. Hawaiian and other Pacific Echini. The Pedinidæ . . . . Temnopleuridæ . . . . Mem. Mus. Comp. Zool. XXXIV. p. 326.

Through the kindness of Prof. R. Hartmeyer I have been able to reexamine the type and only known specimen of Studer's *Amblypneustes grossularia* which has so long puzzled the Echinologists. The cursory examination of it which I have previously had the opportunity of undertaking in the Berlin Museum (Op. cit.), disclosed the important fact that it has not four pairs of pores to each ambulacral plate, as stated by Studer, but only three, and made me doubt that it could really be an *Amblypneustes*. The careful examination, which I have now been able to undertake, has shown that it is, indeed, no *Amblypneustes*, but belongs to the genus *Pseudechinus*, being a close relation of *Pseudechinus Huttoni* — as, indeed, already suggested by Studer himself, who states (Op. cit. p. 874): „Vielleicht ist diese Art identisch mit der von Hutton angeführten *Arbacia*[1]) *globator*, von welcher Hutton genau die gleiche Färbung angiebt, welche von der der supponierten Art bedeutend abweicht".

To the detailed description given by Studer a few supplementary remarks may be given. First of all it should be pointed out that there are no sutural pores; indeed, I do not understand, how Studer has come to state the presence of these pores along the ambularcal sutures, no more than I understand, how he has found four pairs of pores to each ambulacral plate. There are 22 ambulacral, 18 interambulacral plates in the type specimen, which measures 20 mm h. d. 18 mm in height. No crenulation is seen

[1] A lapsus calami for *Salmacis*.

on the tubercles. The genital plates carry one larger tubercle near the inner edge; genital pores only beginning to develop, distinct only in one of the plates. Ocular pores indiscernible; Ocular I is broadly insert. The central plate is smooth, fairly large. Hardly a single miliary tubercle to be observed on the whole apical system (Fig. 17). The buccal plates carry a number of ophicephalous pedicellariæ (probably also triphyllous; this cannot be ascertained definitely, most of these pedicellariæ having been rubbed off.[1])



16. 17.

Fig. 16. Apical system of *Ps. variegatus.* $^{15}/_{1}$.
Fig. 17. Apical system of *Ps. grossularia.* $^{9}/_{1}$.

Regarding the pedicellariæ I may refer to the description and figures given in the „Siam-Echinoidea". No tridentate pedicellariæ are found in the type specimen. The tubefeet contain fairly numerous bihamate spicules.

It is easily seen that this species is nearly related to *Pseudechinus Huttoni,* with which it agrees especially in the colour of test and spines. That it is, however, a distinct species is evident enough. It differs from *Huttoni* in its nearly globular shape and in the scarcer tuberculation; further, the apical system is different, the genital plates being more bare than in *Huttoni.* Also the fact that genital pores have not yet been formed at a size of 20 mm h. d., while in *Huttoni* they are developed already in specimens of only 15 mm h. d., is a noteworthy difference. And then the fact that *Huttoni* is known only from the seas off the South Is-

[1]) This feature also conspicuously distinguishes this form from *Amblypneustes,* in which (— as also in *Holopneustes* —) upon the whole nothing but the buccal tubefeet is found on the buccal plates and on the peristomial membrane.

land is of importance; it is highly improbable that this notable form could have been entirely overlooked in the Northern Seas, and there is not the slightest reason why the species should have such a remarkably disrupted distribution, occurring all round the South Island to reappear only at the northernmost extremity of the whole area.

This type of Echinoids, the genus *Pseudechinus*, which appears to be confined to the New Zealand seas, thus has been shown to have undergone a rich specialization here, being represented by no less than four different species, two in the Southern, two in the Northern region of this area. That these species form two distinct groups, *albocinctus* and *variegatus* on one side, *Huttoni* and *grossularia* on the other side, is evident. It is, indeed, very well possible that they should rather form two separate genera.

10. *Evechinus chloroticus* (Val.).

Echinus (Psammechinus) chloroticus. Hutton. 1872. Catalogue Echinod. New Zealand. p. 11.

Evechinus chloroticus. A. Agassiz, 1872. Rev. of Echini. p. 128, 502. Pl. IV. b. Fig. 7.

— — H. Farquhar. 1897. A contribution to the history of New Zealand Echinoderms. Journ. Linn. Soc. Zool. XXVI. p. 188. Pl. 14, Fig. 9.

— — H. Farquhar. 1894. Notes on New Zealand Echinoderms. Trans. N. Zealand Inst. XXVII. p. 194.

— — H. Farquhar. 1898. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. p. 320.

Heliocidaris chloroticus. Th. Mortensen. 1903. Ingolf-Echinoidea. I p. 115—116. Pl. XIX, Figs. 6, 12, 29, 39.

— — H. L. Clark. 1912. Hawaiian and other Pacific Echini. The Pedinidæ .... Echinidæ .... Mem. Mus. Comp. Zool. XXXIV. p. 281.

Evechinus rarituberculatus. F. Jeffr. Bell. 1887. Description of a new species of Evechinus. Ann. Mag Nat. Hist. 5. Ser. XX, p. 403. Pl. XVII. 7—8.

For the older literature reference may be given to the works quoted of Agassiz and Farquhar).

The description and excellent figure given by Agassiz (Op. cit.), combined with the additional information especially on the pedicellariæ found in my „Ingolf"-Echinoidea, make this character-

istic form sufficiently well known. I may notice that I have a specimen of 124 mm diameter of test (from Pegasus Bay, Stewart Island), which may be a record size. Regarding the pedicellariæ a little additional information may be given — only dried material having been at my disposal formerly. The globiferous pedicellariæ have a short neck; the glands are double. The tridentate pedicellariæ in larger specimens grow to a considerable size, nearly 2 mm length of head, and are very coarse, covered by a thick, dark pigmented skin. Together with this large form a smaller form may occur, identical with that which I have represented in the „Ingolf"-Echinoidea, Pl. XIX, fig. 7, as characteristic of *Evechinus rarituberculatus* Bell. I, accordingly, agree with H. L. Clark[1]) and Farquhar that this species of Bell cannot be distinguished from *Evech. chloroticus*. The small form of tridentate pedicellariæ is the more common in young specimens, but the large form may also be found even in quite young specimens of only ca. 10 mm diameter. On the buccal plates are found ophicephalous and triphyllous pedicellariæ, on the plates of the buccal membrane only triphyllous ones. The spicules of the tubefeet are very scarce, simply bihamate. The figures given by Farquhar (Journ. Linn. Soc. Zool. Vol. XXVI, Pl. 14, fig. 9) as representing spicules of the tubefeet of *E. chloroticus* in reality represent plates from the supporting ring (the „psellion" of Lovén) of the sucking disk.

It may still be noticed that the spines of very young specimens are distinctly banded with green and white; in such young specimens also the poriferous zones are white, the naked test thus being white with 10 radiating, dark green lines; also the apical system, excepting the outer part of the genital and ocular plates, is white. But already from a size of ca. 10 mm diameter the test has the characteristic uniform green colour. The genital openings do not begin to form till a rather late stage; I have found the first indication thereof in specimens of ca. 20 mm. In a specimen of only 6 mm diameter Oc. I hardly reaches the periproct as yet; in a specimen of 8 mm already Oc. I is broadly in contact with and Oc. V just reaching the periproct.

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[1]) Also in regard to the use of the names *Evechinus* and *Heliocidaris* I agree with Clark and Döderlein.

11. *Heliocidaris tuberculata* (Lamk.).

Strongylocentrotus tuberculatus. A. Agassiz. 1872. Revision of the Echini. p. 165, 449. Pl. V. b. 4—5.

— — H. Farquhar. 1897. Contribution to the Hist. of N. Z. Echinoderms. Journ. Linn. Soc. Zool. XXVI. p. 189.

— — H. Farquhar. 1898. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc N. S. Wales. p. 317.

Toxocidaris — Th. Mortensen. 1903. „Ingolf"-Echinoidea. I. p. 125, 139. Pl. XIX. Figs. 4, 8—9, 13.

— — W. B. Benham. 1911. Stellerids and Echinoids from the Kermadec Islands. Trans. N. Z. Inst. XLIII. p. 160.

Heliocidaris — H. L. Clark. 1912. Hawaiian and other Pacific Echini. Pedinidæ etc. Mem Mus. Comp. Zool. XXXIV, p. 281, 350.

— — L. Döderlein. 1914. Die Fauna Südwest-Australiens. Bd. IV. Echinoidea. p. 477—485.

Non: — *tuberculata*. Th. Mortensen. 1921. Studies of the development and larval forms of Echinoderms, p. 64.

This species was not taken by myself, but two specimens taken at Mokohinau were presented to me by Captain Bollons. This appears to be the only New Zealand locality, from which it is known with certainty. (Comp. also Benham, loc. cit.). Evidently the species is, at any rate, not common at the New Zealand coasts. It is not known with certainty to occur outside the Australian and New Zealand seas.[1])

[1]) In my „Studies of the development and larval forms of Echinoderms" I have described the larva of *Heliocidaris tuberculata*, reared from specimens found at Misaki, Japan. This is in contradiction with the above statement of the occurrence of the species in the Southern Seas only, and needs an explanation.

During my stay at Misaki I had no access to literature, except to Tokunaga's work on the Japanese Echinidæ. In this work (in Japanese) the species so common on the shores at Misaki is recorded as *Strongylocentrotus tuberculatus*. I adopted this (specific) name, having got it wrongly into my mind that I had myself (in my „Ingolf"-Echinoidea) shown the Japanese form to be the true *tuberculatus* — while, in fact, I had given the proof that the Japanese form was really quite different from the true *tuberculatus* from the South sea and should be referred to a different genus, *Anthocidaris*. So completely had that idea got into my mind that I did not at all think of looking up the matter when

12. *Holopneustes inflatus* Ltk.

? *Echinus elevatus*. Hutton, 1872. Catalog. Echinod. New Zealand. p. 11.
Holopneustes inflatus. A. Agassiz. 1872. Revision of the Echini. p. 483.
— — Th. Mortensen. 1904 Echinoidea. Danish Exped. to Siam. Mem. Acad. R. d. Sciences. Copenhague. 7. R. I. p. 107.
— — H. Farquhar. 1907. Notes on N. Z. Echinoderms; with description of a new species. Trans. N. Z. Inst. XXXIX. p. 129.
— — H. L. Clark. 1912. Hawaiian a. o. Pac. Echini. The Pedinidæ . . . . etc. Mem. Mus. Comp. Zool. XXXIV. p. 333.

No specimens of this species were taken by myself, but I received a specimen from Capt. Bollons, which he had found on the beach of Little Barrier Isl. It is a naked test, but there seems to be no doubt that it is really *H. inflatus*, the occurrence of which species at the coasts of New Zealand would thus appear to be definitely ascertained.

It seems very probable that this is the species which was described by Hutton as *Echinus elevatus*. It is true, Hutton himself has informed me that it was the same as *Amblypneustes formosus* (Ingolf-Echinoidea I, p. 104). Considering, however, the difficulty of distinguishing at that time the *Amblypneustes* and *Holopneustes*-species there is no certainty at all that this identific-

writing my work on the larvæ, and it was only now on identifying the New Zealand specimens of *H. tuberculata* that I became aware of my mistake.

In my Ingolf-Echinoidea I have stated the Japanese form to belong to the Toxopneustidæ, not to the Echinometridæ, on account of the structure of the globiferous pedicellariæ. Its larva being found to be of the typical Echinometrid form, this would appear to be a hard blow to my theory of the larval classification being in correspondance with that of the adults. In reality there is no contradiction. The single globiferous pedicellariæ which I had found in the material at my disposal when working out the Ingolf Echinoidea must have come accidentally on to the specimen. In reality the globiferous pedicellariæ of the Japanese form — which appear to be mostly very scarce and found only in young specimens — are of the Echinometrid type, and the species therefore both from the characters of the adult and of the larva belongs to the Echinometrids. I still think that the Japanese species cannot be referred to the same genus as *tuberculatus* and ought to be called *Anthocidaris*, probably *A. crassispina* (A. Ag.), but this is, of course, not the place for a discussion of this question.

ation by Hutton was correct. *H. inflatus* being apparently the only species of the group, the occurrence of which at New Zealand has been definitely settled, the suggestion lies at hand that this was the species mentioned by Hutton. There is nothing in the description either to disprove this suggestion. But, of course, the type-specimen should be reexamined in the light of the more recent researches on the *Amblypneustes-Holopneustes* group, in order to have the question definitely settled.

13. *Echinocyamus polyporus* n. sp.

Pl. VI. Figs. 28—31.

Fibularia australis. Benham 1911. Stellerids and Echinids from the Kermadec Isl. Trans. N. Z. Inst. XLIII. p. 162.

Non: —, — Desmoulins.

Length. mm	Breadth. mm	Height. mm	Pairs of pores in the petals anterior.	anterolateral.	posterior.
13,5	11,5	5	19	19	18—19
13,5	12	5	19 - 20	18—19	18—19
12	11	4	18—19	16	16—17
10	9	4	16—17	15	15—16
8	7	3	14	13	14

Test rather flattened, somewhat arched on the aboral side, generally distinctly concave on the oral side in the posterior part, the anterior part being somewhat raised. The peristome is distinctly sunken. The periproct situated rather exactly in the middle between the mouth and the posterior edge of the test; it is rounded and of the same size as the peristome. The apical system is central; the genital pores considerably larger than ocular pores, apparently of about the same size in both sexes. The petals are very large, reaching nearly the edge of the test; the pore-series of each petal somewhat diverging in the outer part. Pores not conjugated, numbering 16—20 in fullgrown specimens. Tubercles uniform, small.

The internal interambulacral partitions are restricted to the very edge of the test, not radiating inwards (Pl. VI, Fig. 29).

A few specimens of this interesting new species were given me by Captain Bollons, who dredged them in the Cooks Strait, in a depth of ca. 40 meters. Unfortunately all are naked, somewhat worn tests; I cannot, therefore, give any information about the structural characters of spines and pedicellariæ. The characters afforded by the test, especially the unusual size of the petals and the slight development of the internal partitions decidedly disting-

uish this species from all the species hitherto known. In regard to the character of the internal partitions the Australian species *Echinocyamus platytatus* H. L. Clark resembles it, but otherwise that species has no likeness at all to the New Zealand species.

That the species from the Kermadec Isl. recorded by Benham as *Fibularia australis*, is really identical with the present species I can assert definitely, having got some specimens of it from Mr. W. R. B. Oliver in Auckland. That it has nothing with the true *Fibularis australis* to do is evident from the facts that the pores of the petals are not conjugated, as they are in that species, and that internal partitions are present, which they are not in *F. australis*, these two characters being emphasized by Gray, who even thinks them of sufficient weight for making *australis* the type of a separate genus, *Mortonia*. I am inclined to agree with Gray in this view, but never having had the opportunity of examining specimens of the true *F. australis*, I shall not give any definite statement about that question at the present occasion. I would only take the opportunity of stating that the Hawaiian form regarded by H. L. Clark as identical with *F. australis* cannot possibly be so, because its pores are not conjugated as they are in that species. It is true that both the Hawaiian and the New Zealand form resemble *F. australis* rather closely in general shape and in the size of the petals. But the definite statement of Gray that the pores in *australis* are „united in pairs by a cross groove" (Catal. Ech. p. 37) (which cannot be done away with, until it has been proved, by a renewed examination of the type, to be a mistake), shows that these forms cannot be identical.

That the New Zealand form is not identical with the Hawaiian form, which it resembles very much in appearance, is proved definitely by its internal structure, the Hawaiian form having no internal partitions except in the anal interradius.

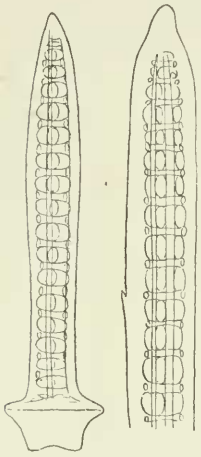
14. *Peronella hinemoæ* n. sp.

Pl. VI. Figs. 22–23: Pl. VII. Figs. 31–35.

Laganum sp. F. Jeffr. Bell, 1917. British Antarctic „Terra Nova" Expedition 1910. Echinoderma. Zoology. Vol. IV. p. 6.

Test nearly circular, thin and flat, the height being only $^1/_5$—$^1/_6$ of the test-length. The edge is not thickened. The oral side is

distinctly and regularly concave, the mouth somewhat sunken. The anal area is situated in the middle between the mouth and the edge of the test. The periproctal plates naked. The petaloid area occupies somewhat less than half the length of the test. The petals are the widest about in the middle. The genital pores are fairly close together, at some distance from the interradial corners of the apical system. They are rather late in appearing, having not yet been found in specimens of 19 mm length. Even in a specimen of 22,5 mm length (in the British Museum, cf. below) the genital pores have not yet appeared.



a b.

Fig. 18. Primary spines of *Peronella hinemoæ*; a. from the aboral, b. from the oral side. $^{120}/_{1}$.

The pedicellariæ (Pl. VII, Figs. 31, 33—34) are of the three usual types and of the structure characteristic of the Laganids, as seen in the figures. Only a small form of tridentate pedicellariæ has been observed; it is sometimes bi-valved. The spines of the usual type. The primary spines are very smooth, those of the aboral side somewhat fusiform (Fig. 18). It is a noteworthy fact that the miliary spines are different on the two sides of the test, the widened ends of the component rods being smooth on those of the aboral side, more or less coarsely serrate on those of the oral side (Pl. VII, Figs. 32, 35). (This holds good also for *P. pellucida*). The colour is slightly reddish; the test not pellucid.

Hauraki Guff, off Hen and Chicken Isl., 100 m, $^{31}/_{XII}$ 1914. One large specimen (31 mm) and three small ones.

Colville Channel, 70 m, $^{21}/_{XII}$ 14. One large specimen (41 mm) and one small, both naked tests.

Two miles E. of North Cape, 110 m, $^{2}/_{I}$ 15. One specimen (37 mm).

The specimens from off North Cape, 70 fathoms, mentioned by Bell (Op. cit.) as *Laganum* sp. („two young specimens, which it is impossible to determine with accuracy") evidently also belong to this species. I have examined the specimens in the British Museum; there are four of them, not two as Bell states, and one of them is fullgrown, 29 mm long, another 22,5 mm long, so that

it is very well possible, if one cares to take the trouble, to identify them with accuracy.

The present species is closely related to the Japanese species *P. pellucida* Döderlein. The main distinguishing characters are these: In *P. pellucida* the oral side is not regularly concave; there is a distinct bulging of the test a little distance from the mouth, especially distinct in the posterior interradius, between the mouth and the anal area; the somewhat sunken posterior ambulacra serve to emphasize the bulging of the anal plastron. Outside the bulging the test is quite flat. This characteristic shape of the oral side serves very well to distinguish *P. pellucida* from *P. hinemoæ*. Further the shape of the petals is somewhat different; in *pellucida* they are the widest in their inner part, the narrowing beginning rather abruptly at about the middle; in *P. hinemoæ* they are the widest about in the middle, then very gradually narrowing outwards. The genital pores are closer together in *P. hinemoæ* than in *P. pellucida*. The test, upon the whole, is more coarse in *P. hinemoæ* than in the Japanese species. In regard to spines and pedicellariæ the only notable difference appears to be that the larger form of tridentate pedicellariæ is not found (at least in the material available) in the New Zealand species. Finally, the Japanese species is not known to occur outside the Japanese seas.

15. *Laganum depressum* Less. (?) [1].

Pl. VI. Fig. 32.

Laganum depressum. L. Agassiz. 1841. Monogr. Scutelles. p. 110. Tab. 23. fig. 1—7.
— — A. Agassiz. 1872. Revision of the Echini. p. 138, 518. Pl. XIII. f. Figs. 5—8.
— — De Meijere. 1904. Siboga-Echinoidea. p. 114. Taf. VI. Fig. 57; Taf. XVIII, Fig. 317—318.
— — H. L. Clark. 1914. Hawaiian a. o. Pacific Echini. Clypeastridæ etc. Mem. Mus. Comp. Zool. XLVI. p. 45. Pl. 124. Figs. 7—12.

[1] I have accepted H. L. Clark's distinction of the genera *Laganum* and *Peronella*, the former comprising the species having 5 genital pores, the latter those with only 4. This may not be in full accordance with the true interrelations of the different forms, but for the present this distinction is the most convenient.

Through Captain Bollons I received a single specimen, taken off Hen and Chicken Islands in a depth of 55 meters. Unfortunately, it is only a naked test, so that I have no means of ascertaining, whether the New Zealand form agrees with the typical *L. depressum* also in the microscopical characters of the spines and pedicellariæ. The shape of the test agrees very well with the said species, only the anal area is scarcely so close to the edge of the test as is usually the case in this species; also the edge of the test is rather more flat than it is generally the case in *L. depressum*. The specimen is 38 mm long, 32 mm broad.

It is quite possible that this species, which is new to New Zealand, will ultimately prove to be different from *L. depressum*, but for the present it must be referred to that species. As it is known to occur in Australian seas it is not surprising to find it also in New Zealand seas.

It does not seem possible that it could be this species which has given rise to the statement of *Laganum rostratum* occurring in New Zealand seas. (A. Agassiz. Revision of the Echini. p. 523). Whether *rostratum* be a good species or not, its very different shape, and especially the fact that *L. rostratum* has four genital pores, the present form five, would seem to preclude the idea that they could have been confused. Most probably it is only a wrong label which has caused the said statement.

16. *Arachnoides zelandiæ* Gray.

Pl. VI. Figs. 21—25; Pl. VII. Figs. 25—30.

Arachnoides zelandiæ. J. Gray. 1855. Catal. Recent Echinida in the Coll. of the Brit. Mus. p. 14. Tab. II. Fig. 2.
— — Hutton. 1872. Catal. Echinod. New Zealand, p. 12.
— *placenta*. A. Agassiz. 1872. Revision of the Echini; p. 530. Pl. XIII, b. Figs. 1—4.
— *zelandiæ*. S. Lovén. 1875. Études sur les Échinoidées, p. 34. Pl LII, Figs. 251—255.
— *placenta*. Farquhar. 1894. Notes on New Zealand Echinoderms. Trans. N. Z. Inst. XXVII, p. 197.
— — Farquhar. 1898. Echinoderm Fauna of New Zealand. Proc. L. Soc. N. S. Wales. p. 321.
— Benham. 1907. Sci. Res. N. Z. Governm. Trawling Exped. Echinoderma. Rec. Canterbury Mus. I. p. 28.

Non: *Arachnoides placenta* (Linn.).

In his „Revision of the Echini" (loc. cit.) A. Agassiz states to have compared specimens of *A. placenta* with Gray's type-specimen of *A. zelandiæ* and found no difference between them which could be considered as specific. He therefore makes *A. zelandiæ* simply a synonym of *A. placenta* and later authors[1]) have followed him unhesitatingly in regarding the New Zealand form as identical with the Australian-Indo-Pacific form, quite overlooking the careful description and analysis of the two forms given by Lovén, by which it is proved beyond any doubt that the New Zealand species is absolutely distinct from the Australian-Pacific form. How Agassiz came to the result that the characters pointed out by Gray as distinguishing *A. zelandiæ* from *A. placenta* were not valid, is hard to say. Probably he has, by some mistake, compared specimens only of the New Zealand species. At any rate, the Fig. 3, Pl. XIII. b. of his „Revision of the Echini" shows conclusively that the species he has described and figured under the name *A. placenta* is really *A. zelandiæ*. Evidently the authors following Agassiz in regarding the two species as identical have simply relied on the authority of Agassiz, without examining the question themselves. It is especially curious that H. L. Clark, although he points out as an unusual zoogeographical fact that *A. placenta* occurs both at New Zealand and the Malay Peninsula (Hawaiian a. o. Pac. Echini. The Clypeastridæ etc. p. 43), apparently did not think of reexamining the question of the identity of the two forms.

Although the characters of the two species have been very carefully set forth by Lovén, it may not be superfluous to point out here again the differences between them.

The most conspicuous difference is that of the relative width of the ambulacral and interambulacral areas — the character which lead Gray to distinguish *A. zelandiæ* as a separate species.[2]) In

[1]) In my „Studies of the development and larval forms of Echinoderms" 1921. p. 96, I have also designated this species as *Arachnoides placenta*. I had at that time not had the opportunity of looking into the matter myself and simply followed the general use, the more confidently so as the identity of the New Zealand species was accepted by H. L. Clark in his great work on the Clypeastroids.

[2]) Gray's statement that in *A. placenta* „the outer ambulacral bands are only half as wide as the interambulacral ones" evidently is a lapsus calami; it is the interambulacra which are much narrower than the ambulacra.

A. zelandiæ the interambulacra are, at the edge of the test, on both the oral and the aboral side, about half as wide as the ambulacra, in *A. placenta* they are only about $^1/_4$ as wide. But much more important is the fact, disclosed by Lovén, that in *A. placenta* the second, third and, partly, the fourth ambulacral plates of the adjoining radii meet in the interradial midline, only one pair of interambulacral plates being found on the oral side in each interradius at the edge of test. In *A. zelandiæ* only the second ambulacral plate joins with that of the neighbouring radius, there being 2—3 pairs of interambulacral plates in each interradius at the edge of the test (Pl. VI. Figs. 24, 26). In *A. placenta* there is a naked furrow on the oral side in the posterior interradius; this is not found in *A. zelandiæ*. The peristome is distinctly larger in *A. zelandiæ* than in *placenta* and is pentagonal in the former, nearly circular in the latter. The statement of Lovén that in *A. placenta* the apical system is distinctly posterior to the middle of the test, while in *zelandiæ* it is distinctly anterior, seems to me less constant. Also the differences in the shape of the test and the position of the periproct, pointed out by Lovén, appear to be less constant.

According to Lovén there is still another remarkable difference between the two species, viz. that in *A. placenta* the first interambulacral plate disappears totally in larger specimens, while in *zelandiæ* it remains large and distinct. In the few specimens of *A. placenta,* which I have been able to examine, this does not hold good; I find the primary interambulacral plate still quite distinctly marked off, even in a specimen of 62 mm length. Upon the whole, the shape of buccal rosette differs considerably from that shown in Lovén's figures (Comp. Pl. VI. Fig. 26 with Pl. LI. Fig. 248 of Lovén; both specimens are of the same size, 45 mm long). This fact would seem to indicate that still another species will have to be separated from *A. placenta*. I have no material for deciding this question at present. The specimens at my disposal are from Cape York, Queensland.

Regarding the shape and structure of the pedicellariæ (Pl. VII. Figs. 25, 28) *A. zelandiæ* does not differ essentially from *A. placenta* (Comp. H. L. Clark. Hawaiian a. o. Pac. Ech. The Clypeastridæ etc. Pl. 125. Figs. 1—3). Only one kind of pedicellariæ

occur; they have as a rule only two valves, but samples with three valves are met with now and then. They are mainly found on the oral side in the non-poriferous areas, especially in the adoral part. They vary very considerably in size; the small ones are perhaps more rightly to be considered as representing the triphyllous form. The tubefeet have a thin, calcarous ring, in one piece, as is the case in *A. placenta*. The spines are exceedingly diversified, being quite different in the poriferous and the non poriferous zones, so that there are ten radiating stripes both on the oral and aboral sides. On the oral side the spines of the non-poriferous zones are considerably longer than those of the poriferous zones, ca. 1,5 mm against 0,5—0,7 mm; they are almost straight, slightly tapering, closely and finely serrate, excepting the point. Those of the poriferous zones (Pl. VII. Fig. 30) are characteristically bent, slightly thickened. The spines of the aboral side are of uniform length, excepting a few longer spines in the interradi near the apical system. Those of the non-poriferous zones (Pl. VII. Fig. 27) are extraordinarily thickened at the point, those of the poriferous zones like those of the oral side, only somewhat shorter. Of the miliary spines those of the aboral non-poriferous zones are rather long, straight, with a fairly thick cap of skin at the point (Pl. VII. Fig. 29), the others shorter, curved, with no cap of skin (Pl. VII. Fig. 26). It is a noteworthy fact that those spines, situated along the furrows on the oral side, form like a roof cover — especially distinct in *A. placenta* —. Evidently those furrows have a special function, perhaps serving for conducting food to the mouth by means of a ciliary current — or perhaps they have a respiratory function. —

In regard to the spines there is quite a conspicuous difference between the present species and the Queensland specimens of *A. placenta*; especially the spines of the non-poriferous zones of the oral side are distinctly shorter and those of the aboral side less thickened at the point. But I shall not enter upon these details at the present occasion.

I found this species in great numbers in quite shallow water on a bottom of a sandy mud in the Inner-Harbour of Napier. A specimen of 128 mm length, taken in Wellington Harbour was given me by Captain Bollons. This appears to be a record size.

The species is not known to occur outside the New Zealand seas.

17. *Echinobrissus*[1]) *(Oligopodia) recens* (Mr. Edw.).

Pl. VIII. Figs. 1—14.

Echinobrissus recens.		A. Agassiz. 1872. Revision of the Echini. p. 108; 556. Pl. XIV a. Figs. 24. XXI b. Figs 1—2. XXXVIII. Figs. 30—31.
—	—	Hutton. 1872. Catal. Ech. New Zealand. p 13.
—	—	Farquhar. 1898. Ech. Fauna New Zealand. Proc. Linn. Soc. N. S. W. p. 321.
—	—	Farquhar. 1907. Notes on New Zealand Echinoderms. Trans. N. Z. Inst. Vol. XXXIX. p. 128
Oligopodia	—	H. L. Clark. 1917. Hawaiian and o. Pacif. Echini. The Echinoneidæ, Nucleolitidæ, Spatangidæ. Mem. Mus. Comp. Zool. XLVI. p. 108. Pl. 144. Figs. 8—11.

Some specimens were dredged in Paterson Inlet, Stewart Isl., in 10—30 meters, and off Stewart Island in 40 meters, in November 1914. I further succeded in dredging a series of specimens of various sizes, from quite young to fullgrown, in the entrance of Wellington Harbour in 10—12 meters depth. (These latter were partly used for embryological studies; comp. the authors work „Studies of the development and larval forms of Echinoderms, 1921. p. 117). Finally, I have received from Captain Bollons some specimens of various sizes, mainly naked tests, from the Foveaux Strait and from Cooks Strait (ca. 90 meters). This fairly rich material enables me to give some additional information of this very interesting Echinoid.

The characters of the test are fairly well known. I would only point out a characteristic feature in the arrangement of the ambulacral pores near the peristome (the „floscelle"). The three adoral pores are in a straight line; from the fourth the pores make an outward curve, the ambulacra being from here about twice as broad as in the innermost part. At the same time a doubling of the pores takes place so that an outer, close series and an inner, more open series are formed, the latter forming a direct continuation of the pore

[1]) I am not inclined to agree with H. L. Clark that the familiar name *Echinobrissus* has to be abandoned, because it is pre-Linnean. But I cannot enter here upon a discussion of this or other nomenclatural questions.

series of the narrow adoral part. There are thus four distinct series of pores in the adoral part of the ambulacra. The buccal membrane contains numerous small, irregular spicules (Fig. 19); in young specimens a single larger, fenestrated plate may be found lying off each ambulacrum, in larger specimens this plate has disappeared. The plates of the periproct are covered with small spines.

It is a noteworthy fact that the specimens turn green on preservation in alcohol, as is the case also with the Clypeastrids. The largest specimen in hand measures 50 mm in lenght.

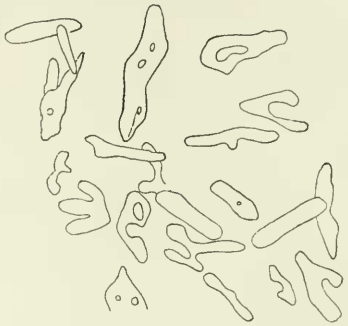


Fig. 19 Plates from the bucal membrane of *Echinobrissus recens* in their natural position. $^{135}/_{1}$.

The pedicellariæ are mentioned only by H. L. Clark, who has found them to be very scarce and only of three kinds, viz. tridentate, triphyllous and ophicephalous. There is, however, great variation as regards their numbers; sometimes they are very numerous, especially in younger specimens, but also in fullgrown specimens they may be quite numerous. Besides the three forms, mentioned by Clark, I find also globiferous pedicellariæ to occur in this species.

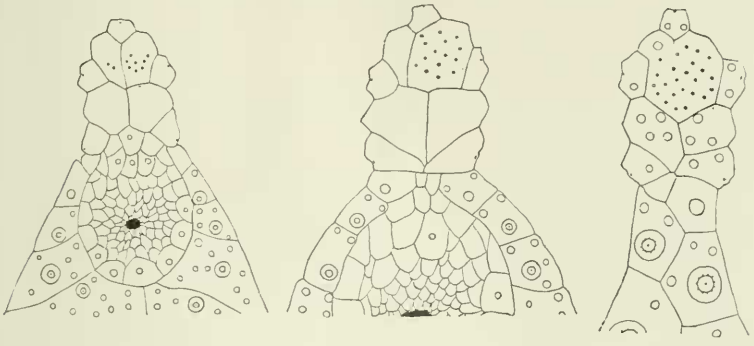
The globiferous pedicellariæ, which are especially numerous in the younger specimens, have a very peculiar structure (Pl. VIII, Figs. 6—8). The valves are almost triangular, the comparatively narrow basal part passing, without any constriction, directly into the blade, which is broad, open. There is a fairly large tooth at each outer corner and 3—4 somewhat smaller teeth betweeen these at the outer edge, which is straight cut, not produced to carry an end tooth. The glands apparently have not the shape of distinctly limited sacs but only consist of some glandular tissue, situated round the outer end of the valves; but this cannot be ascertained without a careful, histological examination for which my material is not fit. There is no neck; the stalk is compact, rather robust, ca. 0,5 mm long. These pedicellariæ, with their large, generally brownish heads, therefore, are very conspicuous among the short spines. The tridentate and ophicephalous pedicellariæ

need no detailed description; reference to the figures given here (Pl. VIII, Figs. 12—13) and to Clark's description will suffice. The ophicephalous pedicellariæ are generally very long-stalked; the cross-piece at the tip of the loop of the largest valve may sometimes be well developed, but as a rule it is not developed, as stated by Clark. The head is sometimes invested in a rather thick pellucid skin. (Preservation may have something to do with this feature) The triphyllous pedicellariæ are described and figured by Clark as wide and flat, with the blade simply oval. This is, evidently, due to a mistake; probably it is a pedicellaria of another Echinoid, accidentally lying among the spines of *Echinobrissus,* which Clark has struck upon; such a thing is by no means a rare occurrence (comp. above, sub. *Heliocidaris tuberculata*, p. 175). The triphyllous pedicellariæ of *Echinobrissus* are of quite another, rather unique shape, although easily referable to the usual shape of this type of pedicellariæ (Pl. VIII, Fig. 11). The blade makes a sharp fold in the middle so as to form a distinct keel, reaching almost down to the apophysis. The edge of the blade is rather coarsely serrate, the serration continuing along the keel. The sphæridiæ are quite smooth, the stalk very distinctly set off; they are attached in fairly deep grooves, but not concealed. In adult specimens they are found in the number of 5—6, attached close to each tubefoot of the inner series, thus forming two longitudinal series in each ambulacrum. The spicules of the tubefeet are peculiar, straight, smooth rods with rounded ends and a small, rounded median prominence. They are very regularly arranged, lying obliquely, in two rows, all with the processes turning outwards. The sucking disk is provided with a fairly well developed calcareous ring, consisting of 4—5 somewhat irregular parts (Pl. VIII, Figs. 10, 14). The ambucral gills contain a few spicules of the same kind as those of the other feet; they even have a trace of a calcareous ring in the point.

The spines are very smooth; the primary ones are simply tapering, the miliary spines distinctly widened at the point. (Pl. VIII, Fig. 9).

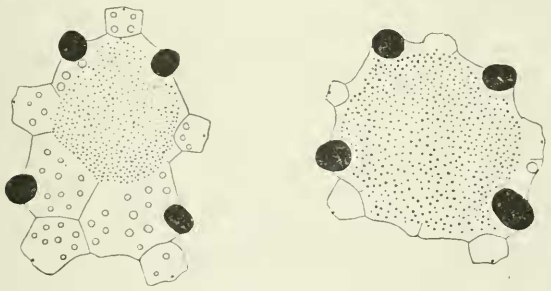
The young specimens in my material afford a most desirable opportunity of studying the growth changes of this rare form. In the youngest specimens, only 5 mm long, the outline of the test is already the same as in the adult; but the peristome is in the middle of the oral side, while in the adult it is distinctly anterior. The

outline of the peristome is perfectly round; in specimens of ca. 10 mm length it is distinctly transversely oval, while in the adult specimens it assumes a more pentagonal shape, the primary plate of the posterior interambulacrum being somewhat larger than the



a. b. c.

Fig. 20.



a. b.

Fig 21.

Fig. 20. Apical system and posterior interradius of *Echinobrissus recens*: a. from a specimen 5 mm long, with the periproct still directly in contact with the apical system: b. from a specimen 7 mm long; the periproct nearly separated from the apical system; c. from a specimen 11 mm long: the periproct widely separated from the apical system. $^{21}/_{1}$.

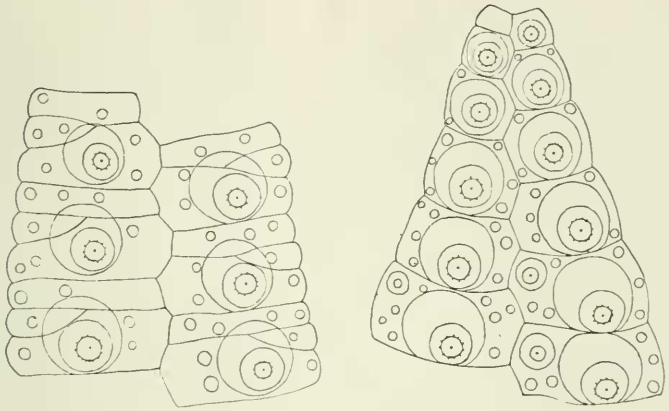
Fig. 21. Apical systems of *Echinobrissus recens*. a. from a specimen 50 mm long; b. from a specimen 40 mm long. $^{8}/_{1}$.

other primary plates, forming an incipient labrum. In the youngest specimens the whole underside of the test is flat, the peristome being perfectly flush with the test. Gradually it then becomes more and more sunken, till in the adult it lies quite deep, with vertical borders, the whole underside being somewhat sunk in the midline.

In the youngest specimens the periproct is still in direct contact with the apical system and is hardly at all sunken. In a specimen, 7 mm long, it is nearly separated from the apical system, the upper interambulacral plates nearly joining in the midline above it; at a length of 8 mm it is separated from the apical system by two pairs of interambulacral plates. In the youngest specimens (5—7 mm) the five ocular plates and the four genital plates are distinct, the madreporite being still, at least in the main, confined to the right anterior genital plate. At a size of 11 mm the madreporite has occupied also the left anterior genital plate, these two plates being no longer distinctly limited against one another. The two posterior genital plates, on the other hand, generally remain distinct also in the adult, the madreporite not encroaching upon them; sometimes, however, the madreporite occupies the whole of the apical system. (Figs. 20—21). The genital pores may appear at a size of ca. 9 mm; in a specimen 11 mm long they have, however, not yet been formed.

The petals begin to form rather early; at a size of 8—9 mm there are 3—4 petaloid pores in each series, at a size of 11 mm there are 8 of them in the three anterior, 11—12 in the posterior petals. In the largest specimen the number of the pores is 32 in the three anterior, 36 in the two posterior petals. The pores are not very distant, slightly conjugated. The arrangement of the pores in double series round the peristome has begun already in the youngest specimens in hand. In the young specimens the ambulacral plates are distinctly seen to be arranged in triads. In each compound plate the lowermost primary plate is the largest, the middle a small, demi-plate, the uppermost a narrow, but complete plate. The lowermost carries a large, primary tubercle. (Fig. 22a). Also each interambulacral plate carries a distinct primary tubercle in the younger specimens. The secondary tubercles, however, soon increase greatly in number, and as they reach the same size as the primary tubercles the series of primary tubercles, which make a very conspicuous feature in the young, are soon quite indiscernible. The tubercles are distinctly crenulate and perforate. They are surrounded by fairly deep areoles, being placed excentrically therein, viz. at the lower anterior edge. (This arrangement evidently must be an adaptation to the habit of burrowing in a coarse, gravelly

bottom, the stronger muscles on the posterior side of the spine basis lending especial force to the backward movement of the spines, the animal thus being pushed forward through the ground). In the young specimens the areoles are comparatively large, confluent and make a very prominent feature. (Fig. 22 b). The miliary tubercles are confined to the narrow lines between the areoles and thus show a more or less distinct circular arrangement round the primary tubercles. Glassy tubercles are not found.



a. b.

Fig. 22. Part of ambulacrum (a.) and (right anterior) interambulacrum (b.) of *Echinobrissus recens*: from a specimen 11 mm long. The ambulacral pores open obliquely on the plates, so as to be invisible except in oblique view: they lie in the normal place, forming a straight series. $^{24}/_{1}$.

In the interior anatomy it is noteworthy that fairly large interradial outgrowths are found on the watervascular ring, corresponding to the „Polian vesicles". The intestinal appendix is conspicuously folded, in the younger specimens it has, indeed, quite a remarkable Annelid-like appearance. The content of the digestive organs is remarkably coarse, consisting — besides smaller unbroken shells, Foraminifera — of fragments of shells, Bryozoa etc., so large that it is hardly intelligible how they could possibly pass through the small mouth. Evidently it must be capable of widening even to the borders of the peristome.

The outstanding feature in the anatomy of *Echinobrissus* is, how-

ever, this that **there is a well developed dental apparatus in the young specimens.** The lantern (Pl. VIII, Figs. 1—2) is conspicuously unequally developed, the anterior part being the smaller, the posterior part the larger. It is much inclined in the lower part, the interpyramidal muscles being large, while in the upper part it is quite vertical. The surface for the attachment of the interpyramidal muscle is smooth, not striated. The foramen magnum is fairly deep, not bridged over by the epiphyses. Styloid processes not visible from the outside. The epiphysis is a small, compressed plate, fit into a slight impression on the upper part of the pyramid; it is of a peculiar shape, high in the outer part, the inner part low, forming like a small handle (Pl. VIII, Figs. 3—4). No pits in the pyramid on the attachment face for the epiphysis. The brace is reduced to a very small plate (Pl. VIII, Figs. 1, 3b) lying at the inner, adoral end of the furrow between each two adjoining pyramids. This furrow shows three narrow, parallel, rounded ridges; the two outer ridges are the epiphyses, the median the compass (Pl. VIII, Fig. 1). This is divided in two, sometimes three pieces. They differ conspicuously in shape from that typical of the compass, being high, compressed, with the upper edge somewhat thickened, not thin, cylindrical as usual. This is in correspondance with the fact that they are fastened between the epiphyses, not lying free above the pyramids as does usually the compass. The teeth are keeled; the pulpa small. The protractor muscle is fastened to the first interambulacral plate, the retractor muscle to the ambulacral auricules, which are simple, rounded prominences. The intercompass muscle is very slightly developed and seen only with difficulty; but in good light it may be seen distinctly and there is no doubt of its existence. Radial compass muscles, on the other hand, are absent.

It is quite evident that the dental apparatus is larger in a specimen of 7 mm than in one of 5 mm in length, so that accordingly a growth has taken place along with the increasing size of the animal. The more remarkable is the sudden change which then occurs, the whole apparatus being completely absorbed in the course of rather short time. In a specimen, 9 mm in length, only some half absorbed rests of the pyramids are found lying round the mouth (Pl. VIII, Fig. 5). In a specimen, 11 mm long, some traces of the lantern are still discernible; in specimens beyond that size the whole dental apparatus

has completely disappeared. The auricles were found to be completely absorbed in the specimen of 11 mm.

The discovery of the young *Echinobrissus* having a well developed dental apparatus which disappears completely long before the animal has reached its full size, is a most interesting parallel to Westergren's discovery of a dental apparatus in the young *Echinoneus*,[1]) and leads to the suggestion that a dental apparatus will be found to exist also in the young of *Echinolampas* and upon the whole in the Cassidulids.

It is a surprising fact that the lantern of *Echinoneus* and of *Echinobrissus* have proved to be of very different structure. (In *Echinoneus* the compass is typically developed, bifid, radial compass muscles being present. The lantern is erect and perfectly regular. The whole apparatus has disappeared already in specimens, 5 mm long). As pointed out by Jackson („Phylogeny of the Echini", p. 189) the lantern of *Echinoneus* recalls to a striking degree that of *Arbacia*, and, upon the whole, of the Stirodonta, which would tend to show that the Echinoneids are derived from that group of the regular Echinoids. The imperforate character of the tubercles is in good accordance herewith. The dental apparatus of *Echinobrissus*, on the other hand, is of a markedly different character, showing no relation to the Stirodonta; it recalls the Clypeastroid lantern in its main features, especially it has a surprising likeness to the lantern of *Echinocyamus*. The Clypeastroid affinity of *Echinobrissus* is also expressed by the peculiarity that it turns green on preservation in alcohol, or on being damaged, a property so highly characteristic of the Clypeastroids. (I am not aware, whether *Echinoneus* has the same property). Further the larva shows Clypeastroid affinities.[2]) It would thus seem evident that Echinobrissus, and, consequently, the Cassidulids upon the whole, are not nearly related to the Echinoneids, but that these two groups are of entirely dif-

[1] A. Agassiz. On the existence of teeth and of a lantern in the genus Echinoneus. Amer. Journ. Sc. 4. Ser. vol. 28. 1909 p. 490—92. Pl 2. A. M. Westergren. Echinoneus and Micropetalon, Rep. Sci. Res. Exped. to the Tropical Pacific, U. S. Fish. Comm. Steamer „Albatross". 1899—1900. XV. Echini. Mem. Mus. Comp. Zool XXXIX. 1911.

[2] Th. Mortensen. Studies of the development and larval forms of Echinoderms. 1921. p. 118.

ferent phylogenetic origin. I cannot enter more nearly on this interesting problem on the present occasion. It may only be pointed out that the character of the compound ambulacral plates of *Echinobrissus* — which have been shown to be of the Echinoid type — will be of importance for settling the question, where the ancestral form is to be looked for. Also the structure of the globiferous pedicellariæ — which recall those of *Stomopneustes* — may prove to be of importance in this connection.

The statement that *Echinobrissus recens* occurs at Madagascar („Rev. of Echini", p. 108) doubtless rests on unreliable labelling of specimens from older collections. It is not known with certainty to occur, outside the New Zealand waters. If an *Echinobrissus* should prove really to occur at Madagascar, it will no doubt turn out to be another species.

18. *Echinocardium australe* Gray.

Amphidotus zealandicus Gray. Hutton. 1872. Cat. Echinod. New Zealand, p. 14.
Echinocardium australe. Farquhar. 1895. Notes on New Zealand Echinoderms Transv. N. Z. Inst. XXVII. p. 196.
— — Farquhar. 1897. A Contribution to the hist of N.Z Echinoderms: Journ. Linn. Soc. Zool. XXVI. p. 187.
— Farquhar. 1898 On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. p. 322.
— — Th. Mortensen. „Ingolf". Echinoidea II. p. 149.
— — Benham. 1909. Echinoderma. Sci. Res. N. Z. G. Trawling Exp. Rec. Canterbury Mus. I. p. 28.
— *cordatum.* H. L. Clark. 1917. Hawaiian a. o. Pacif. Echini. The Echinoneidæ . . . . . Spatangidæ. Mem. Mus. C. Zool. XLVI. p. 262.

Numerous specimens, mainly small ones, were dredged off Tiri Tiri, Auckland, in a depth of 30 meters. Further I have taken three specimens in Queen Charlotte Sound, 6—20 meters, and one, somewhat abnormal, specimen in Paterson Inlet, Stewart Isl., in a depth of 30 meters.

As I have pointed out in my work on the „Ingolf" Echinoidea it seems hardly possible to distinguish the Pacific form from the European *Echinocardium cordatum*, and H. L. Clark has taken the decisive step, declaring that „he would be a hardy zoologist who would maintain *australe* as a species distinct from *cordatum*". When I have retained the name *australe* here I do not mean to state therewith as my definite opinion that the Australian-New Zealand form is a distinct species; it is, indeed, only the discontinuous distribution which makes me still hesitate in definitely accepting it as identical with the European form. That the New Zealand form is identical with the Australian seems unquestionable.

In some of the specimens from Tiri Tiri I have found globiferous pedicellariæ — such had not hitherto been observed in the Australian-New Zealand form. They prove to be quite similar to those of the European form. They were mostly found on the labrum, sometimes, however, on the aboral side in the posterior interradius, always few in number.

19. *Brissopsis Zealandiæ* n. sp.

Pl. VI, Figs. 33–34.

Two specimens, middle-sized, dredged off Bare Island, in 75 meters; mud bottom. $^{17}/_{XII}$ 1914.

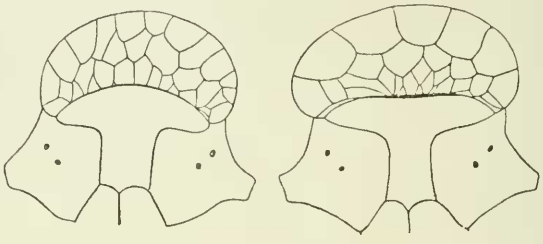
Although it is rather undesirable to augment the number of species within this perplexing genus, I do not see how to avoid establishing a new species for these specimens. Referring them simply to the species with which they appear to be the nearest related, *Br. Oldhami* Alcock, would give a zoogeographical result, not warranted by facts. If it should ultimately turn out that the New Zealand form cannot really be kept separate from that species, little harm is done by its having provisionally been named separately, attention thereby being called to it and further study of it invited. It is briefly thus characterized:

Petals only slightly sunken, the posterior ones rather diverging, somewhat shorter than the anterior ones. Frontal ambulacrum slightly sunken; posterior end of the test rather sloping. Oral side rounded, the plastron being somewhat raised. Labrum prominent, its posterior prolongation ending off the middle of the first ambulacral plate. Five

ambulacral plates are included within the subanal fasciole, the first of them being no. 6.

Pedicellariæ are very scarce in the two specimens, only a few rostrate and some small tridentate forms being found, the latter being of the simple, leafshaped type. No characters of specific value are afforded by these pedicellariæ.

That this species cannot be identified with *Br. luzonica,* which is recorded in the „Challenger" Echinoidea as taken off New Zealand (St. 168, 40° 28' S. 177° 43' S., 1100 fms)[1]), is beyond doubt, partly on account of the shape of the petals, partly because the shape



a. b.

Fig. 23. Peristome, labrum, and adjoining ambulacral plates of *Brissopsis zelandiæ* (a) and *Br. luzonica* (b.). 5,5/1.

of the labrum is different it being distinctly less prominent in *luzonica* and generally somewhat concave at the anterior border (Fig. 23); also the mouth is rather sunken in the present species, while in *luzonica* the mouth-region is almost flush with the test. From *Br. Oldhami* it likewise differs in the shape of the petals, and further the number of plates included within the subanal fasciole is different, 4 in *Oldhami*, 5 in the present species. Here is, however, a questionable point. In my „Ingolf" Echinoidea II. p 168 I have stated *Br. Oldhami* to have five ambulacral plates reaching within the subanal fasciole, while Koehler[2]) asserts that only four plates are crossed by the fasciole

[1]) These specimens need reexamination in the light of the more recent researches on the *Brissopsis*-species. The great depth at which they were found is not in favour of their being identical with either the true *luzonica* (which, according to the researches of Koehler, appears to be mainly a shallow-water form) or the present species.

[2]) R. Koehler. An Account of the Echinoidea. I. Spatangidés. Echinoderma of the Indian Museum. Part VIII. Calcutta. 1914. p 226.

— as is also plainly seen in his Pl. XV, Fig. 12 — remarking that my statement seems inexplicable. I may take the opportunity of asserting here that the specimen examined by me has, indeed, five ambulacral plates reaching within the fasciole. The specimen, which was sent me under that name by Alcock himself, may, however, more correctly be referred to *Br. bengalensis* Koehler (it resembles very much his Pl. XV. Fig. 1); but this does not do away with the discrepancy, as also this latter species has only 4 plates reaching within the fasciole. I do not see how to reconcile these facts; perhaps my specimen is just an individual variation. Another point to which I may call attention is the different shape of the petals in the two specimens of *Br. Oldhami* figured by Koehler in his work quoted above, Pl. XIV, Figs. 1 and 2. I would rather say that the specimen Fig. 1 has divergent posterior petals — in fact, were it not for the different number of plates included within the subanal fasciole I would be very much inclined to regard the New Zealand specimens as identical with the species figured there. An extensive material will be needed for the solution of these problems; but that must be reserved for future studies.

Explanation of the Plates.

Plate VI.

Figs. 1—2. *Goniocidaris umbraculum* Hutton. Showing different degree of widening of the apical radioles. $^1/_1$.

— 3. *Ogmocidaris Benhami* n. g., n. sp. $^1/_1$.

— 4—6. — — denuded test, seen from the aboral (Fig. 4) and oral side (Fig. 5) and in side view (Fig. 6). $^1/_1$.

— 7. *Notechinus novæ-zealandiæ* n. sp. $^1/_1$.

— 8—10. — — denuded test, seen from the aboral (Fig. 8) and the oral side (Fig. 9) and in side view (Fig. 10). $^1/_1$.

— 11—12. *Pseudechinus albocinctus* (Hutton), from the oral (Fig. 11) and aboral side (Fig. 12). $^1/_1$.

— 13—15. — — denuded test from the aboral side (Fig. 13), in side view (Fig. 14) and from the oral side (Fig. 15). $^1/_1$.

Fig. 16. *Notechinus novæ-zealandiæ,* Varietas; side view. $^{1}/_{1}$.
— 17. *Pseudechinus Huttoni* Benham, from the aboral side. $^{1}/_{1}$.
— 18—19. — — denuded tests, from the aboral side. $^{1}/_{1}$.
— 20—21. — *variegatus* n. sp. Two partly denuded specimens, from the aboral side. $^{1,5}/_{1}$.
— 22—23. *Peronella hinemoæ* n. sp.; partly denuded specimen, from the aboral (Fig. 22 and oral side (Fig 23). $^{1}/_{1}$.
— 24—25. *Arachnoides zelandiæ* Gray. Denuded test from the oral (Fig. 24) and aboral side (Fig. 25). $^{1}/_{1}$.
— 26—27. — *placenta* (L.). Denuded test from the oral (Fig. 26) and aboral side (Fig. 27). $^{1}/_{1}$.
— 28—31. *Echinocyamus polyporus* n. sp. Fig. 28 side view; Fig. 29 the interior of the test, showing the internal partitions; Fig. 30 the aboral, Fig. 31 the oral side. $^{1,5}/_{1}$.
— 32. *Laganum depressum* (Less.). From the aboral side. $^{1}/_{1}$.
— 33—34. *Brissopsis zealandiæ* n. sp. From the oral (Fig. 33) and aboral side (Fig. 34). $^{1}/_{1}$.

Plate VII.

Figs. 1—2. Valves of Globiferous pedicellariæ of *Ogmocidaris Benhami.* $^{150}/_{1}$.
— 3. — — — - *Cidaris* sp. $^{225}/_{1}$.
— 4—5. — — — large form of *Notechinus novæ-zealandiæ*, in side view (Fig. 4) and from the inside (Fig. 5). $^{150}/_{1}$.
— 6. — — — large form of *Notechinus novæ-zealandiæ,* Var.; in half side view. $^{150}/_{1}$.
— 7—8. — — — small form of *Notechinus novæ-zealandiæ;* from the inside (Fig, 7) and in side view (Fig. 8). $^{150}/_{1}$.
— 9. — tridentate — of *Notechinus novæ-zealandiæ*, half side view. $^{150}/_{1}$.
— 10. — ophicephalous — of *Notechinus novæ-zealandiæ;* from the inside. $^{150}/_{1}$.
— 11. — triphyllous — of *Notechinus novæ-zealandiæ;* $^{150}/_{1}$.
— 12—13. — globiferous — of *Pseudechinus Huttoni,* in side view (Fig. 12) and from the inside (Fig. 13). $^{150}/_{1}$.
— 14. — tridentate — of *Pseudechinus Huttoni.* $^{150}/_{1}$.
— 15. — triphyllous — - — — $^{150}/_{1}$.
— 16. — tridentate — - — — $^{150}/_{1}$.
— 17. Point of miliary spine of *Pseudechinus Huttoni.* $^{85}/_{1}$.
— 18. Valve of ophicephalous pedicellaria of *Pseudechinus Huttoni.* $^{150}/_{1}$.

Fig 19 Valve of globiferous pedicellaria of *Pseudechinus variegatus.* $^{150}/_{1}$.
— 20. Miliary spine of *Pseudechinus variegatus.* $^{85}/_{1}$.
— 21. Valve of ophicephalous pedicellaria of *Pseudechinus variegatus.* $^{150}/_{1}$.
— 22. — triphyllous — — — $^{150}/_{1}$.
— 23. Tridentate pedicellaria of *Pseudechinus variegatus.* $^{150}/_{1}$.
— 24. Valve of ophicephalous pedicellaria, elongate form, of *Pseudechinus albocinctus.* $^{150}/_{1}$.
— 25. — bidentate pedicellaria of *Arachnoides zelandiæ;* from the inside. $^{150}/_{1}$.
— 26. Miliary spine from poriferous zone of *Arachnoides zelandiæ.* $^{135}/_{1}$.
— 27. Primary spine from non-poriferous zone of aboral side of *Arachnoides zelandiæ.* $^{135}/_{1}$.
— 28. Bidentate pedicellaria of *Arachnoides zelandiæ.* $^{150}/_{1}$.
— 29. Miliary spine from non-poriferous zone of aboral side of *Arachnoides zelandiæ.* $^{185}/_{1}$.
— 30. Primary spine from poriferous zone of oral side of *Arachnoides zelandiæ.* $^{135}/_{1}$.
— 31. Ophicephalous pedicellaria of *Peronella hinemoæ.* $^{150}/_{1}$.
— 32. Miliary spine from the oral side of *Peronella hinemoæ.* $^{290}/_{1}$.
— 33. Valve of tridentate pedicellaria of — — $^{290}/_{1}$.
— 34. — triphyllous — — — $^{290}/_{1}$.
— 35. Miliary spine from the aboral side of — — $^{290}/_{1}$.

Plate VIII.

All Figures of *Echinobrissus* (*Oligopodia*) *recens* (M. Edw.).

Fig. 1. Lantern of a specimen, 5 mm long, seen from above; b brace; c. compass; d. tooth; e. epiphysis. The opening in the middle of the figure is the oesophagus which is seen to have five large folds. The small oval body indicated adorally to each tooth represents the Polian "vesicle". $^{32}/_{1}$.
— 2. Lantern of a specimen, 7 mm long, in side view. $^{32}/_{1}$.
— 3. Dental pyramid from a specimen, 7 mm long, seen from the inside. To the right the brace and compass have been removed, so as to show the shape of the epiphysis (e), which has remained in situ. The left side shows the brace (or rotula) (b) and the compass pieces (c) in situ. The tooth (d) is seen in its place. $^{32}/_{1}$.
— 4. Half-pyramid, from the adradial side, showing the smooth, non-striated surface for the attachment of the interpyramidal muscle. The epiphysis has been removed, a corresponding impression being seen at the upper end of the pyramid. From a specimen, 7 mm long. $^{32}/_{1}$.
— 5. Oral region of a specimen, 9 mm long, from the inside, showing the half absorbed remnants of the lantern. $^{12}/_{1}$.
— 6. Globiferous pedicellaria. $^{85}/_{1}$.
— 7. Valve of globiferous pedicellaria, side view. $^{150}/_{1}$.
— 8. — — — from the inside. $^{150}/_{1}$.

Fig. 9. Miliary spine. $^{150}/_{1}$.
— 10. Spicules from tubefoot. $^{450}/_{1}$.
— 11. Valve of triphyllous pedicellaria. $^{180}/_{1}$.
— 12. Ophicephalous pedicellaria. $^{85}/_{1}$.
— 13. Tridentate pedicellaria. $^{85}/_{1}$.
— 14. Tubefoot, showing the biserial arrangement of the spicules; the sucking disk has been turned so as to show the calcareous ring in full view. $^{150}/_{1}$.

14—10—1921.